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Vol. 13, No. 22
November 30, 1988

Energy Research Abstracts

Abstracts 50343-52946

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ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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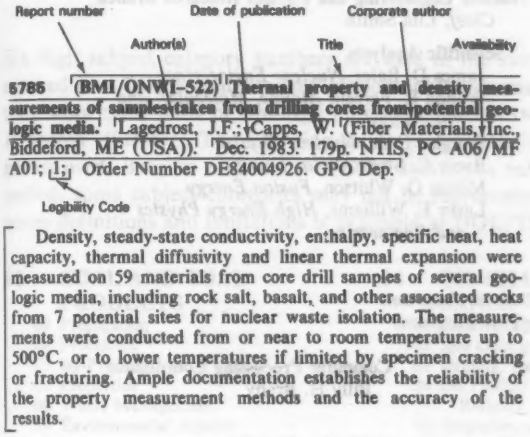
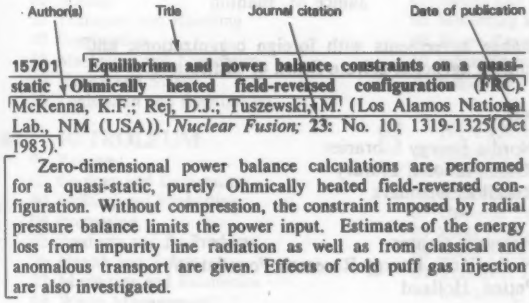
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; Order Number DE84004926. GPO Dep.
Legibility Code
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

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Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 51375

50343 **(MMIJ—8801) Proceedings of 1988 Spring Symposium of The Mining and Mettallurgical Inst. of Japan.** (Japan Mining and Metallurgical Inst., Tokyo). Apr 1988. 524p. (In Japanese). NTIS (US Sales Only), PC A23. Order Number DE88754547/JAW.

The symposium was held in April 4 - 6, 1988. Total number of the presentation was 263, the break down of which is as follows: The 1st. day: History of mining (4). Minerals treatment and environment (10). Solvent extraction (7). New materials (7). The 2nd. day: Resource exploration and assessment. Resources polycy and economy. (14). Ocean development and fluid transportation (18). Rock dynamics (19). Coal (11). Mineral treatment (21). Wet refining (24). New materials (16). The 3rd. day: Limestone, aggregate, mining machineries, prospectiong (16). Rock dynamics (18). Safety (16). Minerals treatment (22). Dry refining (19). New metals (21). This report consists of 524 pages.

0103 Preparation

REFER ALSO TO CITATION(S) 50486, 50487, 50590, 52159

50344 (EPRI-CS—5713, pp 1.1-1.8) **Coal quality and the electric utility future.** Leva, J.R. May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

This paper discusses the advantages of improved coal quality to power plants. Clean coal reduces transportation and pulverizer costs; it improves the availability and efficiency of boilers and precipitators; it can help extend plant life; and clean coal improves the power plant's ability to meet environmental regulations. Environmental legislation and what power plants can expect in the future are discussed. Innovations in Penelec's power plants are briefly described, as is the coal cleaning test facility at Homer City, Pennsylvania.

50345 (EPRI-CS—5713, pp 2.1-2.15) **Benefits of improved quality coal at Pennsylvania Electric Company's Keystone station.** Higgins, S.T. (Pennsylvania Electric Co., Johnstown (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

Cleaning the coals at the Keystone Generating Station has had positive effects on station performance. No effort has been made to convert these benefits into dollars and cents reductions in operating costs, since there are other contributing factors that also have taken place at the same time. Also, one must factor into these the limitations in the amount of data available since the cleaning plant went into operation versus the amount of prior data. Nevertheless, remarkable improvements have been shown and it is assumed that if everything else remains the same, these improvements should continue.

50346 (EPRI-CS—5713, pp 3.1-3.23) **Tennessee Valley Authority's experience with switching to improved quality coal.** Smith, S.R. (Tennessee Valley Authority, Chattanooga (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

Coal quality varies according to the amounts of mineral matter and other contaminants present in the coal as it is delivered to the power plant. Reduction of these contaminants by physical coal preparation processes and selective mining practices is known to improve the efficiency and performance of the power plant. Improved coal quality also reduces the costs of operating and maintaining coal-related equipment in the plant. At Tennessee Valley Authority's Cumberland and Paradise fossil plants, coal preparation was initiated to reduce the quantity of sulfur in the coal for environmental reasons, but the operational benefits of reduced mineral matter content partially offset the cost of compliance with the environmental regulations. Equipment modifications and additions, plant efficiency, maintenance costs, pulverizer wear rates, and coal-related forced outage rates are discussed for both plants. The Cumberland data clearly show improvement in operation due to improved coal quality. Paradise Fossil Plant data do not show these trends as clearly as do Cumberland Fossil Plant data due to construction of scrubbers, total rehabilitation of the furnaces, and major capital improvements. Perhaps also the units at Paradise (cyclone, wet bottom originally designed to burn poor quality coal) are less sensitive to coal quality changes than the Cumberland units. There was no effort in this study to put cost savings on the improvements in performance, because the full story is still evolving at these plants, but there is strong evidence that improved coal quality has contributed to cost savings as well as environmental benefits. 11 figures, 3 tables.

50347 (EPRI-CS—5713, pp 7.1-7.60) **Engineering approach to prediction of fuel impacts on utility boiler systems.** Nurick, W. (Nurick & Associates, Inc., Laguna Hills, CA (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

An engineering analysis model was developed with the limited objective of defining, for selected systems, the potential relative impacts of coal cleaning on plant performance. Performance is defined by specified performance factors which in combination define unit operation. This model has been developed and tested against pilot-scale test data obtained under separate contracts with Combustion Engineering, as well as verified by comparison with full-scale unit operations. This report documents the model's approach, and provides verification of model predictions. While the model is designed for a generic boiler, it can be applied on a unit-specific basis. Although model, as currently configured, compares excellently with actual operating unit data, it is still considered preliminary as the model is continually being upgraded. Additional verification of the model is needed, and several of the key process empirical relationships must be refined. 16 references, 26 figures, 13 tables.

50348 (EPRI-CS—5713, pp 8.1-8.24) **Benefits of coal cleaning on the capital and operating costs of a 550 MW boiler.** Hervol, J.D.; Mehta, A.K.; Levasseur, A.A.; Miemiec, L.S.; Lexa, G.F. (EPRI-CCTF, Homer City, PA (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

The Electric Power Research Institute (EPRI) is sponsoring a comprehensive program to assess how coal cleaning affects utility boilers. As part of this program, EPRI conducted a two-part study in 1984-85 on behalf of the Canada Centre for Mineral and Energy Technology (CANMET) to perform a coal cleanability characterization and to determine the effect cleaning has on the combustion performance characteristics of Hub Seam coal from Nova Scotia, Canada. Investigators at EPRI's Coal Cleaning Test Facility (CCTF) in Homer City, Pennsylvania, performed a comprehensive series of coal cleaning tests that produced a medium- and a deep-cleaned coal for subsequent combustion testing; engineers at Combustion Engineering's (C-E) Kreisinger Development Laboratory in Windsor, Connecticut, conducted bench-scale and pilot-scale combustion tests on raw Hub Seam coal and the two clean coals. Test results on the raw coal and two levels of clean coal were used to estimate the capital and operating costs of three hypothetical 550 MW (gross) boilers. Results indicate that improvements in combustion performance characteristics due to coal cleaning can provide significant equipment and operating cost savings. Break-even fuel cost estimates, based upon combined capital and operating cost savings, indicate that 13% higher fuel costs for the medium-cleaned coal and 29% higher costs for the deep-cleaned coal are possible for equivalent steam generating costs.

50349 (EPRI-CS—5713, pp 10.1-10.26) **Role of coal cleaning in integrated environmental control.** Cichanowicz, J.E.; Harrison, C.D.; Krajewski, M.J.; Nold, D.G.; Robie, C.P. May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

The strong dependence of environmental control costs on coal composition requires that fuel selection and coal quality decisions support environmental control strategies. This premise is fundamental to the concept of integrated environmental control (IEC). The IEC approach equally evaluates all operations from fuel mining to waste management for their contributions to environmental control. This paper summarizes how coal cleaning allows the most simple and least costly environmental controls to be applied. First, it reviews changes in fuel composition due to, and the costs for, coal cleaning. It then summarizes higher boiler efficiencies made possible through lower air heater gas exit temperatures. Finally, it summarizes the potential of cleaned coal to simplify equipment and reduce environmental control capital and operating costs.

50350 (EPRI-CS—5713, pp 11.1-11.14) **Coal cleaning to reduce sulfur dioxide emissions.** Parkinson, J.; Suardini, P. (EPRI-CCTF, Homer City, PA (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

The quantity of coal cleaned before firing in utility boilers has substantially increased since imposition of the Clean Air Act in 1971. Because sulfur dioxide (SO_2) emission reductions achievable by coal cleaning depends largely on characteristics of each coal, national average reduction statistics are of little value to utilities in evaluating coal cleaning as part of a SO_2 emission control strategy. The Electric Power Research Institute (EPRI) is therefore evaluating the SO_2 reductions achievable by cleaning specific coals. It is also identifying other benefits to power plant operations achieved by improving the quality of the coals they burn. This paper presents actual SO_2 reductions achieved on 18 diverse coals using common commercial coal-cleaning processes and discusses other power generation benefits associated with firing clean coal.

50351 (EPRI-CS—5713, pp 12.1-12.8) **Experience with combined coal cleaning and flue gas desulfurization.** Smith, S.R. (Tennessee Valley Authority, Chattanooga (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

This is a written summary of a panel discussion in which Tennessee Valley Authority's experience with combining physical coal cleaning (PCC) and flue gas desulfurization (FGD) was used as a starting point for discussing the future role of PCC to reduce SO_2 emissions in response to acid rain legislation. The Tennessee Valley Authority (TVA) operates a 2550 MW coal-fired electric generating station in western Kentucky. The station includes a 2000-ton per hour heavy-media coal cleaning plant, three cyclone-fired boilers, and two wet limestone FGD systems. The passage of acid rain legislation will lead to an increase in utility dependence on state-of-the-art PCC and FGD systems. TVA has made a very preliminary investigation of the costs and compliance techniques that could be required for TVA plants under several variations of potential acid rain legislation, including low sulfur coal, least emissions dispatching, and FGD.

50352 (EPRI-CS—5713, pp 13.1-13.12) **Applying EPRI's coal cleaning cost model.** Petrovic, L.J.; Zawadski, E.; Hervol, J.D. (Resource Engineering, Inc., Waltham, MA (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

A Coal Cleaning Cost Model (CCCM) has been developed for the Electric Power Research Institute (EPRI) by Bechtel Group, Inc. to rapidly estimate at the feasibility level the capital and operating costs of modern coal cleaning plants. These plants have various process configurations and sizes ranging from 300 to 2000 tons per hour. Resource Engineering Incorporated of Waltham, Massachusetts, was hired by EPRI in late 1986 to test the flexibility and potential variations in results when using the CCCM. In particular, the CCCM was tested on a 1200-tons per hour balanced flowsheet containing coarse and fine coal cleaning circuits. Four approaches were used to evaluate possible variations in estimating methods. They yielded total capital costs ranging from $55 to $82 million and operating and maintenance costs ranging from $2.04 to $3.21/ton of raw coal feed. The major reasons for these differences lie in the labor, engineering services, contingency, and owner's cost factors used to adjust the total direct costs. The CCCM was found to be relatively easy to work with and to have the capability for rapid feasibility-level cost estimates using both the detailed and the summary approaches described in this paper.

50353 (EPRI-CS—5713, pp 14.1-14.11) **Impact of cleaning efficiency on the cost of clean coal.** Akers, D.J.; Cavalet, J.R. (EPRI-CCTF, Homer City, PA (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

In general, the design, and to a lesser extent the operation, of a coal cleaning plant involves a trade-off between costs and efficiency. Equipment which makes a high efficient separation tends to have higher capital and operation costs than less efficient equipment, but the more efficient equipment may provide a higher yield of clean coal at a given quality. Higher yields provide increased amounts of clean coal to offset to some degree the increased costs. This paper provides an overview of such trade-offs. Only gravimetric separation efficiency is used in this paper to illustrate the relationship between coal-cleaning efficiency and clean coal costs. However, in cases in which cleaning is achieved only by sizing or when most of the raw coal is finer than approximately 0.15 mm, non-gravimetric separation efficiency is the dominate factor in cleaning plant performance.

50354 (EPRI-CS—5713, pp 16.1-16.8) **Penelec approach to coal quality control.** Stephens, J.A. (Pennsylvania Electric Co., Johnstown (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

Penelec is committed to employing state-of-the-art techniques to closely control coal quality and achieve maximum boiler efficiencies as well as complying with stringent environmental standards. In the past several years, Penelec has expended about $8 million in capital investments to enhance coal receiving and sampling systems. In addition, approximately one quarter of a million dollars is spent each year for coal sampling and bias testing of automated coal sampling systems. After exploring the backdrop against which Penelec purchases coal, this paper examines (1) the relationship between coal quality and plant performance, (2) the administrative techniques utilized to ensure quality control, (3) the physical controls utilized, including the work done to verify quality control efforts, and (4) the thing that makes all of the above work, a state-of-the-art coal sampling program.

50355 (EPRI-CS—5713, pp B.1-B.54) **Maximizing Btu recovery: multiple stream cleaning and fluidized-bed combustion.** Ehrlich, S. May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

This paper describes a concept in which coal is washed at relatively low specific gravity to produce a very clean coal stream and a waste that would be used to produce more power from existing turbine generators. In the procedure recommended here, the raw coal is shipped to the power plant without cleaning and the cleaning is performed at the power plant. High-ash washery wastes are burned in an FBC. The steam produced in this FBC is piped together with that from the existing PC. boiler to the existing turbine generator. The turbine may or may not need uprating to accept additional steam. A furnace designed for coal may not be able to burn mine wastes efficiently, even assuming that the auxiliary systems were designed to process massive quantities of fuel, limestone, and wastes. In a simple calculation, the authors show that waste fuel (and especially sorbent) only spends 1/10th the time in the furnace designed for coal. They do not claim that this calculation is a design guide. However, it illustrates why pilot plant work can be misleading if the key variables are not understood. Despite these cautions, a very poor fuel was burned in an AFBC with very good results. It is technically practical to burn Paradise and Homer City wastes. But care must be taken. 18 tables.

50356 (EPRI-CS—5713, pp C.1-C.32) **Integrated analysis of coal costs in generation: use of EPRI models.** Mueller, H.A. May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

This paper reviews the role of coal cleaning in overall coal supply costing, the major coal supply cost components, and EPRI tools for coal supply cost analysis. EPRI models used in this review are: coal mine cost model, coal preparation cost model, coal cleaning cost model, a coal routing and costing system, coal quality impact model, fuel inventory model, and contract mix model. The author concludes that EPRI tools can form the backbone of an integrated coal supply economics evaluation program. This paper was presented as a slide presentation.

50357 (EPRI-CS—5935) **Evaluation of coal pulverizer materials: Effect of coal characteristics on wear performance and reliability: Final report.** Donais, R.T.; Tyler, A.L.; Dufrane, K.F.; Glaeser, W.R.; Merriman, T.L.; Wright, I.G. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA); Battelle Columbus Labs., OH (USA)). Aug 1988. 152p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016614/JAW.

This report deals mainly with abrasive wear in coal pulverizers. Eight coals, including bituminous, subbituminous, and lignite, were analyzed in the laboratory to determine their quartz (SiO_2) and pyrite (FeS_2) content. The size distribution of these two minerals was also determined. The wear of Ni-Hard rolls from pulverizers, used to grind the above coals at various utilities, was determined. It was found that wear expressed as mils/1000 ton coal correlated much better with the quartz and pyrite content of the coal than wear expressed as mils/hr. Analysis of the data obtained indicated that the effect of quartz on mill wear is much larger than that of pyrite. Coarser size fractions of both materials also increase wear. Based on the data obtained, an analytical procedure to predict the abrasiveness of coals on their quartz and pyrite content was developed. Laboratory studies were also carried out to compare the wear resistance of various commercially available castings and weld overlays. Little difference was found between two grades of Ni-Hard coatings. The wear resistance of higher chromium weld overlays or cast white irons was found to be about twice as high as that of Ni-Hard castings. This is in good agreement with wear of high chromium weld overlays observed by many utilities. 37 refs., 53 figs., 41 tabs.

50358 (MMIJ—8801, pp 115-116) **Production of CWM with wet type ball mill (part 3). Influence of filled amount of ball and the materials of grinding.** Kokubo, Toshimitsu; Sakamoto, Hiroshi; Oya, Hitoshi; Iwata, Hiroyuki; Yamamoto, mitsuru; Fukuda, Takayuki. (National Research Inst. for Pollution and Resources, Tsukuba, Japan; Shibaura Inst. of Tech., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

In the production of CWM (Coal Water Mixture), high concentration is required from the viewpoint of use efficiency. This greatly affects the particle size composition of coal and the selection of the additive. In this report, a wet crushing by means of a compact ball mill was studied on the influence of ball filling and coal charge on the crushing, influence of the ball size, slurry concentration, and amount of slurry, etc.. Result of crushing by a new 100 liter ball mill was compared. In the wet type ball mill, different from the dry crushing, apparent slurry viscosity increases during the crushing and greatly affects the movement of balls and the crushing. From the viewpoint of batch type fine CWM production, for obtaining higher handling capacity and efficiency, it is desirable to crush while the slurry viscosity is adjusted. (6 figs, 3 refs)

50359 (MMIJ—8801, pp 117-118) **Characterization of CWM (part 2). Influence of particle size distribution.** Suzuki, Shigeyuki; Tanaka, Tadatsugu; Yamagata, Yoshio. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Factors for the conversion of CWM (Coal Water Mixture) into a liquid fuel are (1) Type of coal; (2) Selection of additives; and (3) Particle size dustribution which enables a close-packed structure. In this study, the aim is to characterize the CWM in order to clarify the relation between the particle size distribution and the additives, precipitated volume, and flowability. Sample coal was a Datung coal (China); Particle size distribution index of RBB diagram was set at 0.8, 1.0, 1.2, 1.4, 1.4 and 1.6, and particle size values at 30 micron. Additives were anionic and nonionic. For measurement of flowability, a double cylindrical rotary viscometer was used. A certain correlation was found among the particle size distribution, the precipitated volume and the flowability. (7 figs, 2 refs)

50360 (MMIJ—8801, pp 429-430) **Study on coal flotation with a column flotation apparatus.** Hirashima, Tsuyoshi; Takamori, Takakatsu; Shinohara, Yasuhiro; Tomita, Hiroshi; Tsunekawa, Masami; Yoshida, Yutaka. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan; Muroran Inst. of Tech., Muroran, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

A column flotation apparatus containing concentration measurement cells using laser light was fabricated. With this apparatus, the feasibility of automatic continuous measurements of various factors, including tailings concentration, ash, and yield, and the behavior of coal flotation were studied. The specimen used was slurry of coal from Datong, China. A flotation agent was added to the specimen for emulsification and was fed together with water and air to the column to study (1) the concentration of specimen suspension and laser light attenuation, (2) the actual tailings concentration, and (3) the mass of ash and combustible components. The results have revealed that if the ash content is about 10% or more, fine inorganic mineral particles and relatively large combustible particles are flowed out as tailings so that fine coal particles can be easily floated. The actually measured values well agree with the theoretical curve where they are steady. Automatic continuous measurement using laser light has proved to be feasible to some extent. (5 figs)

50361 (MMIJ—8801, pp 435-436) **Results of online ash content measurement with transmission type coal ash content meter using two radioactive sources.** Onodera, Jiro; Kawaguchi, Hiroshi; Komatsu, Kenshi; Koyanagi, Nobuhiro. (The Coal Mining Research Centre, Japan, Tokyo, Japan; Mitsui Coal Mining Co., Ltd., Miike, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

As part of effort for automatic coal preparation, online ash content measurement was conducted on unprepared low-ash coal and clean coal. Gamma rays from two radioisotopes 241-Am and 137-Cs were irradiated on a coal layer through the conveyer belt. The intensity of the transmitted gamma rays was detected to obtain the indicated ash content through specific arithmetic. The results are as follows: (1) When the ash content meter for low-ash unprepared coal was used, variations in indicated ash content were within 0.6% and the estimated difference between indicated and actually measured ash contents was about 1.5% under the condition of an adequately thick coal layer and steady operation. However, if the coal layer thickness was 40 mm or less or if the specimen contained coarse particles in a large quantity, the indicated ash content varied considerably and was much lower than the actually measured value. A possible reason for this is the effect of gamma rays passing through. (2) When the ash content meter for clean coal was used, the measurement results varied considerably. The reason for this is that the range of ash content indication was narrow and that the coal layer was thin. (4 figs, 3 refs)

50362 (MMIJ—8801, pp 469-470) **Method of saving electric power in Fe-Ni electric furnace.** Kanesaka, Jun; Yamada, Yasuo; Kimura, Takayoshi. (Hyuga Smelting and Refining Co., Ltd., , Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Electrochemical Fe-Ni smelting is advantageous; however, since its principal energy is electric power, a method for power saving must be developed. Attention is focused on the method of burning C heavy oil in an electric furnace. In general, coal to be reduced and ore are mixed and temporarily burnt; the mixture is put into the bin at the top of the furnace; it is fed into the furnace through a charging chute; it is molten and reduced with three electrodes installed in the furnace to separate metal from slag. This time, movable four-tube lances with passages for heavy oil, oxygen, and cooling water (in and out) were inserted in the ore layer in the furnace, and C heavy oil was burnt. The temperature of the exhaust gas was 1100°C, and the thermal balance per lance was about 80%. When the heavy oil intake increased, the electric power consumption reduced. When electric power substitution rate is taken into consideration, the thermal balance is also about 80%. This means that heavy oil is burnt efficiently. (4 figs, 1 tab)

50363 (MMIJ—8801, pp 475-476) **Velocity of reduction of roasted ore and concentrate of zinc pelletized using coal as binder and reducer.** Zan, F.F.; Shinbo, Ryokichi; Asakura, Iwazo; Ogawa, Osamu. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan; Zonnan Inst. of Tech., , China). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

The mechanism of reduction of zinc oxide and zinc sulfide in carbonized briquettes was studied. Carbonized briquettes formed to cylinders (spheres in some cases) were placed in a basket made up of nichrome wires and were heated and reduced in flowing nitrogen. The reduction rate was determined accoding to the specimen weight decrease involved in reduction. For each type (of two types) of roasted ore and concentrate, the relationship between reduction rate and time was plotted at different temperatures. In general, the curve is downward convex at the beginning and gradually becomes upward convex. The curve is not influenced by the specimen shape. The rate-determining process was investigated from the reduction curve with consideration also on factors other than Boudouard reaction. For roasted oxide ore, when reaction proceeds, gas is diffused through the gas boundary film on the ZO particle surface. The rate-determining process on sulfide concentrates is the reaction of changing from CaO to CaS. The difference in reaction rate is caused by the difference between the preset temperature of the specimen and the surface temperature. (6 figs, 2 refs)

50364 (PB—88-866835/XAB) **Coal beneficiation. December 1980-July 1988 (Citations from the Engineering Index data base). Report for December 1980-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 172p. NTIS PC N01/MF N01.

Supersedes PB—85-868958.

This bibliography contains citations concerning laboratory and field investigations of various methods and equipment utilized in coal-beneficiation processes. Grinding, washing, flotation techniques, dewatering, and drying are among the preparation techniques discussed. Some attention is given to combustion characteristics of pulverized coal. Citations pertaining specifically to desulfurization processes are excluded. (This updated bibliography contains 389 citations, 52 of which are new entries to the previous edition.)

0104 Processing

REFER ALSO TO CITATION(S) 50499, 50505, 50508, 50515, 50516, 50519, 50520, 50521, 50583, 50912, 50913, 50914, 50924

50365 **(CRIE-W—86010) Study of 2 T/D pressurized two stage entrained bed coal gasifier's characteristic. In-furnace mass-balance analysis by Canadian coal.** Takahashi, Shuichi; Abe, Toshio; Inumaru, Atsushi; Hamamatsu, Teruhide; Ota, Kazuhiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Sep 1987. 22p. (In Japanese). Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo.

Analysis of test data of 2 T/D coal gasifier gave the following result: 1. Amount of gas formed in the gasifier: it was accurately calculated from the amount of air charged into the gasifier and N_2 concentration in the formed gas. 2. Carbon conversion: this increases as the increase of air ratio in the gasifier. 3. Char production: carbon ratio in the char is controlled by the air ratio in the gasifier, and the ash content in the char increases as the air ratio increases. 4. Conbustor air ratio and balanced char quantity: recycling char quantity abruptly increases as the air ratio in the gasifier is reduced; air ratio of the combustor gets lower accordingly. (23 figs; 4 tabs)

50366 **(CRIE-W—86012) Emission characterisitics of NOx and unburned carbon with pulverized coal fired NR burner.** Nakata, Toshihiko; Makino, Hisao; Ninomiya, Toru; Sato, Mikio. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1986. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770159/JAW.

As the burning conditions of coal are greatly dependent on the burner characteristics, evaluation must be made respectively with various types of burners. Influence of carbon characteristics on NOx and unburned carbon in the ash was clarified by using NR burner. The conclusions are: 1. Conversion rate of fuel N to NOx can be predicted by two factors such as Fuel N and fuel-air ratio. 2. Unburned carbon can be predicted by coal property and as fuel-air ratio. The generality of the evaluation factors was confirmed as the result is similar to the conventional SGR burner. (35 figs, 3 tabs, 8 refs)

50367 **(CRIE-W—86016) Behavior of alkali metal under coal gasification coditions. Theoretical consideration on the basis of evaporation and condensation.** Ito, Shigeo; Makino, Hisao; Matsuda, Hiromitsu. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Oct 1986. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770158/JAW.

Theoretical consideration was made on alkali metals concerning the behavior of trace metal components under coal gasification atmosphere. The results are as follows: 1. Fine particles of alkali metal compounds are dispersed in the coal char, and evaporate within the char under high temperature and diffuse through the fine pores and release to outside. On the basis of this assumption, model of evaporation can be made. NaCl is regarded to evaporate mostly in the furnace. 2. The evaporated metal compound condenses on the char surface as the gas is quenched. Amount of condensation on one particle increases as the particle size increases, and the concentration increases with smaller particle size. 3. A model was constructed to estimate the concentration in the char, considering the amount of evaporation and condensation, residual amount, and change in diameter of char particles of the trace metal compound. (22 figs, 1 tab, 14 refs)

50368 **(CRIE-W—87016) Reverse flow cleaning for ceramic porous filter.** Ito, Shigeo; Makino, Hisao; Watanabe, Masatoshi; Nagayama, Tsutau; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Oct 1987. 44p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754542/JAW.

The caracteristics of reverse flow cleaning for ceramic sintered porous filter(PF) in IGCC power generating system, were studied. The performance of the reverse flow cleaning was improved with increase of the flow rate. For the filtration rate of 2cm/s, the reverse flow rate must be larger than 3cm/s at the filtration surface to achieve the effect of the repititions of reverse gas blowing in a cleaning. The reverse flow rate exceeding 5cm/s is desirable to sufficiently separate the collected dust. Three or four times of reverse gas blowing is sufficient for one time cleaning. Reverse gas blowing time of several seconds is enough since the dust layer falls at the start of blowing. The collected dust amount does not influence greatly on the cleaning performance. If the filtration rate becomes larger in a operation, the cleaning performance is decreased. The reverse flow rate may be increased to recover the performance of the cleaning, but too large filtration rate may result the plugging of PF pores. (35 figs, 2 tabs, 6 refs)

50369 **(CRIE-W—87017) Development of moving bed desulfurization method. Performance of the sorbent and characteristics of the moving bed desulfurization.** Akiyoshi, Hisashi; Matsuda, Hiromitsu; Shirai, Yuzo; Kobayashi, Makoto; Watanabe, Masatoshi; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1987. 38p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754543/JAW.

Performance of a sorbent and 2 ton/d moving bed desulfurizing equipment under high pressure and high temperature condition in the integrated coal gasification combined cycle power generating system were studied. The desulfurization performance of the moving bed sorbent seemed to be improved and stable in the early stage of the cycle when the sorbent was subjected to repeated desulfurization and regeneration cycle. The global reaction rate of desulfurization was proved to be expressed with G=K(1-X)/sup/m/CE, where K is reaction rate constant, X is conversion of reaction, m is order of reaction, C is mole concentration of hydrogen sulfide and E is saturated reaction capacity of H_2S. The sorbent has high conversion of regeneration and is regenerable in the desulfurization and regeneration cycle. In this equipment, it was confirmed that the continuous desulfurization is capable in the moving bed reactor and that the design target (to reduce H_2S concentration to less than 100ppm at the outlet of the reactor from 2000ppm at the inlet) can be sufficiently achieved. (22 figs, 10 tabs, 6 refs)

50370 **(CRIE-W—87018) Long term reliability of desulfurization sorbent for hot coal gas desulfurization. Residual sulfur influence (Part 1).** Shirai, Hiromi; Kobayashi, Makoto; Matsuda, Hiromitsu; Akiyoshi, Hisashi; Tanaka, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Oct 1987. 34p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754544/JAW.

In order to develop the desulfurization sorbent technique in IGCC system, the influence of the residual sulfur on desulfurization/ regeneration cycle of the iron oxide honeycomb desulfurizer to remove sulfur compounds in the hot coal gas was studied. At the reduction cycle, Fe_2O_3 is reduced to Fe_3O_4 and at the same time, the iron sulfate formed at the regeneration cycle is decomposed to release a part of sulfur. The residual sulfur content after the reduction step, is proportional to the residual sulfur content in the sorbent after the regeneration step. At the desulfurization step, iron oxide is converted to iron sulfide by absorbing H_2S. The stoichiometric ratio of Fe to S in the iron sulfide was equal to 1.05+-0.05. The residual sulfur is converted to iron sulfate and increases at higher SO_2 content and lower desulfurization temperature. The residual sulfur was constant during the cycle. From these facts, it was found that the subreaction cycle of iron sulfate {equilibrium} iron sulfide made from iron sulfate converted at the regeneration step. (22 figs, 4 tabs, 9 refs)

50371 **(DOE/FE/55014—T32) Quarterly environmental, safety, and medical report: Second quarter, 1988.** (ANG Coal Gasification Co., Beulah, ND (USA)). Aug 1988. Contract FM02-82FE55014. 236p. NTIS, PC A11. Order Number DE88016257/JAW.

ANG continued permitting activity during the reporting period. These activities include finalizing the revised RCRA Part B permit application; participating in the NDPDES QA/QC program; performing the required integrity tests on the deepwells; initiating a hydrogeologic assessment for the plant site; completing the DOE assigned sections for the modified permit to Construct/Operate application; preparing for the main stack CEM monitor certification test; completing the particle size distribution work on "Donna" coal lock vent; responding to NDSDH concerns about odor complaint followup surveys and lead in the drinking water supply; submitting a renewal application for the construction waste landfill; and requesting approval to dispose of spent shift catalyst in the gasifier ash pit. ANG conducted eight monitoring programs in the vicinity of the Great Plains facility. Major activities for these ambient monitoring programs are subsequently summarized. The RAMP network consists of five monitoring sites, and it is designed to monitor meteorology and air quality in the vicinity of the Great Plains facility and the Antelope Valley and Coyote electric generating stations. There was one exceedence of the air quality standards for TSP during the reporting period. ANG conducts ambient monitoring for H_2S at one site in the vicinity of the Great Plains facility. ANG conducts additional ambient monitoring for SO_2 at two (2) sites in order to ensure that ambient air quality standards are not violated during periods when H_2S- bearing wastes gases are incinerated in the event of temporary SRU shutdown. ANG conducts groundwater monitoring programs on a quarterly basis that are associated with desulfurization-gasifier ash waste disposal, deepwell injection, gasifier ash disposal, and the surge ponds. Major activities on each program are summarized.

50372 **(DOE/FE/55014—T33) Great Plains Coal Gasification Project: Quarterly technical progress report, April-June 1988 [Fourth fiscal quarter, 1987-1988].** (ANG Coal Gasification Co., Beulah, ND (USA)). 29 Jul 1988. Contract FM02-82FE55014. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016256/JAW.

This progress report describes the operation of the Great Plains Gasification Plant, including lignite coal production, SNG

production, gas quality, by-products, and certain problems encountered. (LTN)

50373 (DOE/MC/21063—2603) **A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized-bed gasification system: Process analysis, topical report.** (KRW Energy Systems, Inc., Madison, PA (USA)). May 1988. Contract AC21-84MC21063. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88010267/JAW.

This report presents process analysis of the Process Demonstration Unit (PDU) operations and is a continuation of the process analysis work performed in FY-1980 through 1983 and reported in Process Analysis Topical Report FE-19122-45. Included herein is work performed on PDU process data collected in FY-1984 and FY-1985, covering the following: gasification; ash agglomeration; fines carryover, recycle and consumption; description of temperature and concentration profiles in the fluidized-bed gasifier; development of a mechanistic gasifier model to predict PDU performance; development of a jet temperature model to predict maximum jet temperature; and multiple jet scoping studies. Data collected during the mechanistic test series enabled an in-depth understanding of the PDU behavior, development of dimensionless equations to represent temperature and steam concentrations, and the development of a mechanistic gasifier model and a jet temperature model. Both these models are required to address the effect of various operating parameters on PDU performance and operability. 10 refs., 71 figs., 34 tabs.

50374 (DOE/METC—87/6082, pp 9-19) **Performance evaluation of a screenless (counter-current) granular bed filter on a subpilot-scale PFBC.** Wilson, C.; Cooper, J.; Placer, F. (Combustion Power Co., Menlo Park, CA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objectives of this investigation are: (1) to augment information on the feasibility of a Granular Bed Filter (GBF) for controlling particulate in a Pressurized Fluidized-Bed Combustor (PFBC) power generating system, (2) to assess the design and life of critical components in the filter system, and (3) to estimate costs of a commercial-scale design based on tested concepts. Test facilities and results are described. Application of this research is intended for hot gas cleanup for coal-fired gas turbines.

50375 (DOE/METC—87/6082, pp 28-37) **Evaluation of a ceramic cross-flow filter in a bench-scale gasifier.** Meyer, J.H.; Westervelt, D.; Anestis, T. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21338.

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The Department of Energy is currently supporting a program that will aid in the development of cross flow filtration technology as applied to combined cycle power generation with coal gasification. The stated overall goal is to gain information on both the operational and economic feasibility of the implementation of cross flow filtration in various gasifier options. Most recently the focus has been on demonstration of reliable operations of newly developed commercial scale filter elements in single and multiple element tests at elevated temperatures and pressure. The following provides a brief summary of results and accomplishments from this program's recently active elements: the economic study, the 1000 cycle test, and the first test of a single large filter element.

50376 (DOE/METC—87/6082, pp 38-44) **Ceramic cross-flow filter development.** Dorazio, R.E.; Ferri, J.L. (GTE Products Corp., Towanda, PA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23250.

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The overall objective of this program is to develop low cost manufacturing technologies for ceramic cross flow filter elements. The current technology permits the manufacture of the filters by the process of extrusion-bonding-method. This technique eliminates most of the green machining associated with the fabrication of a complex shape, therefore it offers low cost potential. The parameters that govern permeability of the finished product will be investigated. A technology that may permit even lower cost fabrication of ceramic filters is the process of pressure casting of the matrix. The parallel investigation will focus on the feasibility of this technology for these filter elements. Rheology of slurries containing the ceramic and organic fillers capable of yielding a porous structure will be investigated. The project is described. Preliminary results are given.

50377 (DOE/METC—87/6082, pp 45-57) **Mechanical analysis of a ceramic cross flow filter.** Ciliberti, D.F.; Lippert, T.E.; Kleiner, R.N. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23252.

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The primary objective of this program is to develop a more fundamental understanding of the mechanical forces exerted on a cross flow filter when in operation so that means can be devised to avoid mechanical failures of the filter and reliability can be improved. The ceramic cross flow filter has been demonstrated to be a superior high temperature and pressure barrier filter suitable for application in both oxidizing and reducing atmospheres, however, a recurrent operating problem has been experienced in virtually all developmental programs to date. This difficulty manifests itself in a tendency of the layered filter to delaminate along the surface formed by two adjacent layers. Results are discussed from the pressure stress tests, thermal analysis, and combined pressure and thermal loading.

50378 (DOE/METC—87/6082, pp 58-73) **Development of a novel nested-fiber filter concept for high-temperature and high-pressure physical cleanup.** Conkle, H.N. (Battelle Columbus Div., Columbus, OH (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23251.

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The Nested Fiber Filter (NFF) system is based on the concept of a nest of needle-like fibers made from an alloy suited for the application. Filter action results from particles matter forming dendritic, or chain-like, particulate matter structures on the surface of the fibers. Battelle developed the concept of using nested fibers for a high-temperature filter as part of an internal design study. Baseline experiments were conducted to determine the technical feasibility of the system. Particulate capture levels over 99.9% with 5 micron particles at 230 mm (9.3 in.) water pressure drop were achieved. A system for implementing the concept of nested fibers for use as a high-temperature filter was desired for integration with advanced power systems. This program is directed towards developing a system for implementing the nested-fiber filter concept into a workable system at HTHP. Accomplishments to date are described.

50379 (DOE/METC—87/6082, pp 62-73) **Sidestream zinc ferrite regeneration testing.** Grindley, T. Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

A key factor in the development of hot gas cleanup technology is considered to be a regenerable, high-temperature desulfurization sorbent. Zinc ferrite has been selected for detailed study. This sorbent is typically made in the form of cylindrical extrusions from finely divided zinc oxide and iron oxide ingredients together with inorganic binders and modifiers. The zinc and iron oxides combine to form zinc ferrite in which the zinc is widely dispersed within the spinel crystal structure. Major findings in the project are itemized. The present status is that zinc ferrite sorbents have demonstrated sufficient promise to justify process development with fixed- and

fluid-bed gasifiers. It is expected that desulfurized gas from the process will be combusted in gas turbine trials.

50380 (DOE/METC—87/6082, pp 74-88) **Design studies for hot gas cleanup system in a load following mode.** Gal, E.; Cook, C.S.; Furman, A.H. (General Electric Corporate Research and Development, Schenectady, NY (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC22247.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objective of this project is to apply hot gas desulfurization technology to a simplified IGCC system operated in a load following mode. Simplified IGCC refers to an electric power generation system consisting of a fixed bed, air blown, dry ash coal gasifier, hot fuel gas desulfurization, and a steam-injected aircraft-derivative gas turbine. An adaptation of the hot gas desulfurization design is being developed for installation on an existing air-blown fixed bed gasification facility for proof-of-concept testing. The design characteristics to be evaluated in the proof-of-concept system test include: operation at gasifier pressure and temperature (300 psia, 1100°F); achievement of greater than 90% overall sulfur removal efficiency; reduction of particulate concentration to levels acceptable for gas turbine and NSPS requirements; minimization of net consumption of sorbent material; production of an SO_2-rich regeneration tail gas stream that can be economically treated; demonstration of projected economical operation in a commercial-size system; and generation of a database for a commercial-scale system design. The design includes a complete engineering package for construction of the proof-of-concept system including process flow diagrams, vessel designs, piping and instrumentation diagrams, general arrangement drawings, and equipment specifications. Design studies will address the impact on the cost-of-electricity of this design concept by comparison to previous studies of other coal-to-electricity systems. The project is detailed and accomplishments to date are listed.

50381 (DOE/METC—87/6082, pp 89-99) **Enhanced durability and reactivity for zinc ferrite desulfurization sorbent.** Baltich, L.K.; Berggren, M.H. (AMAX Research & Development Center, Golden, CO (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23172.

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The prime objective of this project is to identify and investigate methods for enhancing the durability and reactivity of the zinc ferrite desulfurization sorbent. The enhancement is to be judged by comparing the reactivity and durability of the sorbents prepared and tested in the program against two base case samples. The objective will be accomplished by preparing a large number of sorbent samples representing modified chemical compositions and agglomeration and induration procedures. Selected samples that meet the requirements of the physical characteristics will be used in sulfidation/regeneration tests to determine their reactivity. These sorbent samples will be characterized before and after testing to determine their durability. The resulting data will be analyzed to categorize the sorbents and establish the chemical composition and agglomerating and induration procedures that result in the most reactive and durable sorbent. Sorbent preparation is described. Results of the single particle kinetic studies and the bench-scale multicycle test program are discussed.

50382 (DOE/METC—87/6082, pp 100-109) **Dynamic simulation models for high-temperature desulfurization processes.** Wang, J.; Cockrill, D.; Groves, F.R. Jr.; Harrison, D.P. (Louisiana State Univ., Baton Rouge (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23089.

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The description of high temperature desulfurization/regeneration reactors consists of coupled, nonlinear partial differential equations which can only be solved by numerical methods. The final equations often represent a compromise in which simplifications are made to satisfy computational constraints. An accurate and detailed model is of little use if the solution cannot be obtained with available computer resources. Likewise, a model which has been so simplified that it no longer mirrors experiment is of little use. Knowledge of numerical mathematics and chemical reaction engineering is required to develop a model which accomplishes both objectives. The reaction engineering analysis must include the heat and mass transfer characteristics, and intrinsic surface chemistry of both the integral reactor and the individual sorbent particles. The objective of the research is the preparation of dynamic simulation models capable of describing both the sulfidation and regeneration cycles in fixed-, fluidized-, and moving-bed reactors. The models should be capable of matching breakthrough curves, sulfur loadings, and temperature fronts obtained from experimental reactors. Results to date are discussed.

50383 (DOE/METC—87/6082, pp 110-122) **Development of a hot gas cleanup system.** Anderson, G.L.; Berry, F.O. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-85MC22144.

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The overall objective of this program is to develop means to remove reduced sulfur-containing compounds (e.g., H_2S and COS) and HCl from hot coal-derived fuel gases for use in advanced power plants such as integrated coal gasification-combined cycle power plants and coal gasification-molten carbonate fuel cell power plants. The program includes four tasks: (1) laboratory-scale studies to optimize the concentration of cobalt titanate in a sorbent used in the mixed metal oxide process; develop an oxygen regenerable zinc oxide/zinc aluminate sorbent for the mixed metal oxide process; and explore the use of less costly molten carbonate mixtures in the IGT hot HCl removal sorbent, (2) construction of a skid-mounted 3000 SCF/h bench-scale hot gas cleanup process test system, (3) integration of the test system with a 6-inch fluidized-bed gasifier at IGT, and (4) testing of the IGT processes with actual hot coal-derived fuel gases in the new bench-scale unit. Results of the optimization of the cobalt titanate sorbent, testing of alternative hot HCl removal sorbents, and construction of a bench-scale test unit are discussed.

50384 (DOE/METC—87/6082, pp 123-137) **Detailed studies of novel regenerable sorbents for high-temperature coal-gas desulfurization.** Flytzani-Stephanopoulos, M.; Jothimurugesan, K.; Lew, S.; Gavalas, G.R.; Patrick, V. (Massachusetts Institute of Technology, Cambridge (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract FC21-85MC22193.

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The overall objective of this work is to study in detail the effects of preparation, chemical composition and structural properties on the reactivity, stability, and regenerability of novel mixed oxide H_2S sorbents over the temperature range of 1000°-1500°F. The sorbents selected for this study include both CuO- and ZnO-based materials. The specific objectives of the project are to: investigate the effects of additives such as Al_2O_3 and TiO_2 on the reduction stability and overall performance of CuO- and ZnO-based sorbents; carry out comparative fixed-bed studies of sulfidation-regeneration with different compositions of sorbents prepared in granular form, and select most promising sorbent types; conduct parametric studies of regeneration of the selected sorbents and correlate sorbent regenerability and composition of regeneration off-gas to regeneration conditions for each sorbent type; and prepare selected sorbents in extruded form with a good balance of porosity and mechanical strength and test best sorbents in many (10-15) sulfidation-regeneration cycles in a lab-scale, fixed-bed reactor. Results are given on the physical properties, chemical composition effects, sulfidation performance, regeneration performance, and sulfate formation of Cu-Fe-Al-O sorbents and on the sulfidation performance, reduction stability, and regeneration of Zn-Ti-O sorbents. Results from the preparation and testing of porous sorbent extrusions of good mechanical strength are also discussed.

50385 (DOE/METC—87/6082, pp 138-146) **Bench-scale testing of novel desulfurization sorbents.** Harkins, S.M.; Gangwal, S.K. (Research Triangle Institute, Research Triangle Park, NC (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23126.

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Hot gas desulfurization represents a significant portion of METC's overall hot gas cleanup research program for power generation using coal gasification. The objectives of this contract are to perform bench-scale evaluation and preliminary engineering/economic assessment of novel high temperature desulfurization sorbents which have shown promising results at the laboratory scale. The emphasis is on testing sorbent formulations which have shown potential for high-efficiency hydrogen sulfide removal down to 1 ppmv and/or for stable operation at sulfidation temperatures greater than 650°C. A project description is given. Preliminary work and results are summarized.

50386 (DOE/METC—87/6082, pp 147-151) **Process development unit for coal gasification tied to regenerative hot gas cleanup.** Duthie, R.; Polen, K.; Calderon, A. (Calderon Energy Co., Bowling Green, OH (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract FG21-87MC24138.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The generic problem being addressed by this grant project is the utilization of coal with any sulfur content in an economical, environmentally acceptable manner. The proposed solution is a new and unique proprietary coal gasification process which is modular in configuration. The purpose of this project is to demonstrate the operation of a commercial scale process module. This includes the engineering, construction and operation at a feed rate of 50 tons per day of high-sulfur (3.2% S) caking coal. The module will operate continuously at pressure (350 psi) and be integrated with its proprietary hot gas cleanup system to yield clean gases free of tars and compounds of sulfur and particulate matter. The complete coal conversion system consists of: a charging mechanism which accepts run-of-mine coal (ROM); a heated vertical pyrolysis tube which removes tars and other volatiles, and agglomerates coal fines; air-blown char gasification with a water-quenching lock hopper for slag removal; separate production of the rich pyrolysis gas and the lean gas from char gasification; hot gas cleanup in which tars are cracked and sulfur and alkali metals are removed in regenerative hot sorbent beds; sorbent regeneration to recover byproduct sulfur; and disposal of inactive sorbent, alkali metals and coal ash as an inert slag. Coal pyrolysis, char gasification, hot gas cleanup, sulfur recovery, combined cycle integration, and thermal efficiency are described for the process. No results are available as yet.

50387 (DOE/METC—87/6082, pp 174-181) **Limestone/dolomite for direct coal-fired turbines.** Newby, R.A.; Kittle, W.F. (Westinghouse R & D Center, Pittsburgh, PA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-85MC22087.

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The objective of this project is to test and evaluate the performance of calcium-based sorbents for sulfur control in direct coal-fired turbines at temperatures up to 1200°C. Calcium-based sorbents are limestones, dolomites or processed forms of these, such as limes and hydrates. Two generic types of gas-solid contacting devices are considered in the program: fluidized bed desulfurizers where relatively coarsely-sized sorbent particles (300 to 1000 micron diameter) are used in shallow, turbulent fluidized contactors; entrained desulfurizers where relatively finely-sized sorbent particles (1 to 50 microns) are injected into the combustion gases. While the program focuses on external desulfurization following complete coal combustion, it also relates directly to internal desulfurization in advanced staged-combustors by its consideration of finely-sized sorbent particles in both SO_2 and H_2S gases. Coarse particle and fine particle results are discussed.

50388 (DOE/METC—87/6082, pp 220-230) **Provide alkali species profiles using a well-characterized coal combustor.** Greene, F.T.; O'Donnell, J.E.; Robaugh, D. (Midwest Research Institute, Kansas City, MO (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21091.

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Alkali metal species have been identified as principal contributors to the corrosion of heat transfer surfaces and turbines in coal combustion and gasification systems. This corrosion often limits the life and operating temperature of these systems. To date, the information on the behavior of alkali species during coal combustion and gasification is very limited. This project was therefore undertaken to obtain data on the behavior of alkali species which would be suitable for testing combustion and gasification models. In this program the species leaving the surface of individual coal particles are measured directly rather than attempting to infer this information from macroscopic measurements in a large-scale combustor. Either individual coal particles or arrays of isolated particles are placed in a radiation field and a gas stream which has a temperature, pressure, composition, and flow rate which simulate PFBC or gasification conditions. The species leaving the coal particle surface are measured as a function of time using molecular beam mass spectrometric (MBMS) techniques. Particle temperatures are measured using optical pyrometric techniques. This paper discusses the identification of the initial inorganic combustion products, typical single particle combustion histories, particle temperature histories and gas temperatures, and sodium reactions following devolatilization. Results to date are summarized.

50389 (DOE/METC—87/6082, pp 231-236) **Fixation of alkali and trace metals in high temperature co-current entrained flow gasifiers and combustors.** Wendt, J.O.L.; Peterson, T.W. (Univ. of Arizona, Tucson (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21386.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objectives of this research are to determine how programmed process temperature profiles and additives influence alkali content of supermicron fly ash particulate matter and of submicron aerosol matter under high temperature gasification and combustion conditions. The research should also shed light on the most important mechanisms governing the fate of alkali metals during pulverized coal combustion and gasification. The research is conducted on a 2 kg/h pulverized coal downflow combustor, operated under fuel lean conditions and fuel rich conditions to simulate combustion and gasification conditions, respectively. The combustor is sufficiently large to simulate times, temperatures, particle/particle and particle/gas interactions as they occur in practical units, but also sufficiently well-defined to allow time resolution of the alkali-rich particulate concentrations to be measured and mechanisms to be inferred. Sampling is performed using a specially-designed isokinetic sampling probe and analysis of particles by atomic absorption, EDAX (energy dispersion x-ray analysis), and Scanning Auger Microscopy. Results to date are discussed.

50390 (DOE/METC—87/6082, pp 237-249) **Measurement of alkali vapors in PFBC process stream and their removal with a fixed granular-bed sorber.** Lee, S.H.D.; Myles, K.M. (Argonne National Lab., IL (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objectives of this work are to critically measure the alkali-vapor (Na and K) concentration in a pressurized fluidized-bed combustion (PFBC) process stream on a real-time, on-line basis and to demonstrate a fixed granular-bed sorber for the control of alkali vapors from the actual PFBC process stream. Three experimental activities have been proceeding during this year: (1) laboratory calibration of the Ames alkali analyzer and the batch-type alkali and particulate sampling train, (2) laboratory study on alkali-vapor capture by stainless steel, and (3) modification of the PFBC/alkali sorber to reduce particulate loading in the PFBC process stream. Results of each activity are discussed.

50391 (DOE/METC—87/6082, pp 250-259) **Study of high temperature removal of alkali in a pressurized gasification system.** Bachovchin, D.M.; Alvin, M.A. (Westinghouse R & D Center, Pittsburgh, PA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The overall objective of this work is to develop, to a point of readiness for scale up to pilot plant level, a specific concept for removal of alkali metal vapors from hot gases. This concept, which is applicable to gasification and FBC systems, is to pass the gases through a fixed bed of emathlite, a natural clay, with which the alkali reacts irreversibly. The bed material is replaced annually. Specific goals, corresponding to program tasks, include: identify a commercial process for fabrication of getter pellets and examine processing costs; determine the mechanism, stoichiometry, and kinetics of the gettering reaction in laboratory studies, to provide the data for reactor scale-up; determine the capacity of the emathlite for sodium gettering, particularly in the presence of low concentrations of sodium vapor; and demonstrate the concept by testing fixed beds (ca 10 kg) of getter pellets exposed to alkali-laden combustion gases and show that the laboratory kinetic data can be used to design fixed bed getter reactors. Experimental methods are described and the most significant results to date are listed.

50392 (DOE/METC—87/6082, pp 260-272) **Applications of organo-calcium chemistry to control of contaminant aromatic hydrocarbons in advanced coal gasification processes.** Longwell, J.P.; Peters, W.A. (Massachusetts Institute of Technology, Cambridge (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21074.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The overall goal is to provide quantitative understanding of the thermal reactions of aromatic contaminants - with emphasis on freshly formed coal pyrolysis tars and benzene - with calcium oxide under conditions pertinent to in situ, or outboard attenuation of these contaminants from advanced coal gasification process and waste streams. Specific objectives are to: study the cracking of fresh coal pyrolysis tar over CaO; study benzene cracking over CaO; determine CaO deactivation behavior; and perform a preliminary assessment of process economic implications. Results to date are given and discussed. 24 references, 6 figures, 4 tables.

50393 (DOE/METC—87/6082, pp 273-286) **Study of the effects of soot, particulate and other contaminants on molten carbonate fuel cells by coal gas.** Klinger, J.; Kennedy, H. (Energy Research Corp., Danbury, CT (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21154.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objective of the program was to study the effects of coal-gas derived contaminants on the performance and endurance of the Molten Carbonate Fuel Cell (MCFC). Additional goals were to evaluate soot deposition due to unstable fuel compositions at typical MCFC temperatures, as well as tar and soot formation due to small amounts of unsaturated and cyclic hydrocarbon contaminants. The goals of this study with respect to contaminant effects were to evaluate, set limits, and suggest clean-up methods for particulates, arsenic, ammonia and trace amounts of volatile metal compounds, including zinc, mercury and Pb-vapor. The present study is one of the first integrated projects to look at the entire spectrum of soot, particulates and contaminant effects both from a short-term fundamental, as well as a longer-term experimental, in-cell, perspective. This paper details the project methodology and summarizes the results. 9 references, 4 figures, 5 tables.

50394 (DOE/METC—87/6082, pp 287-292) **Effects of halides on the performance of coal gas-fueled molten carbonate fuel cell.** Kunz, H.R.; Magee, T.P. (International Fuel Cells, South Windsor, CT (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23136.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objectives of this contract are to develop a model and determine the probable limits of halides in fuel and oxidant streams to achieve a desired coal-gas-fueled molten carbonate fuel cell life between 25,000 and 40,000 hours. The information will be useful in the development of the coal gasifier/molten carbonate fuel cell power plant since it will define the gas cleanup and cell tolerance requirements that enable the mating of the coal gasifier with the fuel cell. The program consists of several tasks. First, a literature survey and thermodynamic analyses were performed to determine the anticipated effects of halides. These results were used to formulate a test plan. The tests consist of laboratory out-of-cell measurement of the performance of anodes and cathodes with halides present in the electrolyte and corrosion measurements on materials of construction. In-cell tests will be performed and all the data modeled to enable the prediction of the effects of halides on cell performance. Results to date are discussed.

50395 (DOE/METC—87/6082, pp 293-302) **Study of ammonia removal in coal gasification processes using integrated systems approach.** Chang, R.; Unnasch, S. (Acurex Corp., Mountain View, CA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23275.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The purpose of this project is to investigate process concepts to eliminate ammonia in the gas stream from a coal gasifier at 1000 to 1800°F. It is the objective of this project to review all previous work and to recommend a preferred approach to achieving the goal of reducing the formation of NO/sub x/ from ammonia to environmentally acceptable levels. The recommended concept will be proven by laboratory-scale experimentation using simulate coal gases. The paper discusses ammonia control approaches. The primary approach recommended for proof-of-concept testing is staged combustion which has the potential of controlling both fuel and thermal NO/sub x/. The second approach to be considered will be a combination of staged combustion and catalytic dissociation. The test plan and experimental systems are described.

50396 (DOE/METC—87/6082, pp 303-312) **Study of ammonia removal in coal gasification processes.** Krishnan, G.N.; Wood, B.J.; McCarty, J.G. (SRI International, Menlo Park, CA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23087.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The objective of this program is to investigate process concepts to eliminate 90% of fuel-bound nitrogen, primarily ammonia, in a temperature range of 540° to 870°C from coal gas streams produced by gasification of bituminous coals. The program is divided into three tasks. (1) Comprehensive review of the literature: identify and assess the effectiveness of concepts for hot gas ammonia removal. Based on a critical review of this information, catalytic decomposition of ammonia was selected as a process concept tat has a significant potential for successful development. (2) Development of an experimental test plan: design a protocol to evaluate the performance of several candidate catalysts selected on the basis of the literature review. (3) Catalyst testing: experimentally screen candidates to identify one superior catalyst. Determine the reaction kinetics of this catalyst to provide a quantitative basis for scale-up of the process. Results from each of these tasks are discussed.

50397 (DOE/METC—87/6082, pp 327-341) **Hot gas cleanup systems analysis.** Craig, K.R.; Koch, R.W. Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The use of high-temperature, high-pressure cleanup processes hold potential for significantly reducing capital and operating costs and increasing efficiencies in coal-based energy production systems. The goal of the hot gas cleanup systems analysis effort at METC is to determine the interaction of novel cleanup processes on the remainder of these energy systems and identify areas where further research could improve efficiency, reduce costs, or increase

a processes chances for development and implementation by the commercial sector. These interactions are determined through engineering analyses conducted using a variety of tools including computerized process models, engineering calculations, and literature studies. Results from the following are discussed: assessment of systems and economic issues for in-bed desulfurization in fixed-bed gasifiers; analysis of performance aspects and tail-gas treatment options in gasification island systems; determination of sulfuric acid industry capacity and production; update of estimate zinc ferrite capital and operating costs; assessment of existing zinc ferrite modeling tools; and determination of applicability of hot gas cleanup for methanol production.

50398 **(DOE/METC—88/6092-Vol.2) Proceedings of the eight annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.** Kothari, V.P. (ed.); Longanbach, J.R. (ed.). (USDOE Morgantown Energy Technology Center, WV). May 1988. 746p. (CONF-880544—). NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88010254/JAW.

From 8. annual gasification and gas stream cleanup systems; Morgantown, WV, USA (10 May 1988).

Research programs presented at the Gasification and Gas Stream Cleanup Systems Contractors Review Meeting are presented. The primary purpose of the meeting was threefold: To review the technical progress and current status of the gasification and gas stream cleanup projects sponsored by the Department of Energy. To foster technology exchange among participating researchers and other technical communities. To facilitate interactive dialogues which would identify research needs that would make coal-based gasification systems more attractive economically and environmentally. More than 320 representatives of Government, academia, industry, and foreign energy research organizations attended the 3-day meeting. Forty-three papers and 31 poster displays were presented summarizing recent developments in the gasification and gas stream cleanup programs. This volume covers sessions three and four on systems for the production of synthesis gas and systems for the production of coproducts. Individual topics within each session are processed separately for the data bases.

50399 (FSJ—8601, pp 107-110) **Relation of the physicochemical structure of coal to its reactivity for gasification.** Haga, Tetsuya; Nishiyama, Yoshiyuki. (Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The effect of the ash content and crystal structure of carbon on the reactivity in the non-catalytic and catalytic gasification reactions of various ranks of coals and chars was investigated. The result from the non-catalytic reaction using six ranks of coal indicates that the order of reciprocal number of CR parameters (the relative intensity of C (002) band in X-ray diffraction pattern) representing the rank of coalification of the carbon structure is the same as that of the reactivity of coals. Comparing the reactivities of the chars prepared from the deashed coals with each other, the degree of the catalytic function of minerals was very low. The result of the examination of CR^{-1} parameter in the non-catalytic reaction varies according to the reactivity of coal. It was found that the effect of the ranks of coal on the crystal structure of char in the Ni-catalytic reaction corresponds to the variation of CR parameter of char. (16 figs, 2 tabs)

50400 **(FSJ—8601) Proceedings of 23rd Conference of Coal Science.** (Fuel Society of Japan, Tokyo). 23 Oct 1986. 372p. (In Japanese). (CONF-8610431—). NTIS (US Sales Only), PC A16. Order Number DE88754546/JAW.

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Ninety five reports of the 23rd (1986) conference on coal science sponsored by Fuel Association of Japan were collected. Seventeen reports on solvents of coal liquefaction, eighteen reports on coke properties and gasifications of coal, and sixty reports on the coal liquefaction were described. About the liquefaction solvents, capacities of hydrogen donor solvents and hydrogenation reactions were mainly presented. About the gasification, characteristics of activated coke, analysis of coal gasification with moving bed gasifier, steam gasification mechanism using catalyst, gasification reactivity, and fusion of coal ash were reported. About coal liquefaction, following reports were compiled into the proceeding: rheological behavior of coal slurry, pretreatment for liquefaction, swelling in heated solvent, liquefaction reactions, distillation of liquefaction products, demonstration operation results on NEDOL process and other liquefaction processes, chemical structures of coal-derived liquid, activities of liquefaction catalysts and so on.

50401 (FSJ—8601, pp 7-9) **Thermochemical studies on the reactivity of model solvent compounds in coal liquefaction.** Kawai, Satoshi; Kageyama, Yoichi. (Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The hydrogen donating power and the ability to inhibit the production of heavier fraction are the most important features for the solvent for coal liquefaction. It is reasonable to use the hydrogen releasing free energy as the indicator of these abilities. The hydrogen releasing (drawing) rate of various hydrogen donating solvents (model solvents) was determined and the relationship between the rate and the change of hydrogen releasing free energy was examined. The hydrogen drawing reaction correlates roughly with the change of hydrogen releasing free energy. The production of heavier fraction closely correlates with the change of hydrogen releasing free energy. This gives the guideline for inhibiting the reaction producing heavier fraction. Since the thermochemical analysis is insulfficient for understanding the reaction rate, it is the future problem to increase the analytical accuracy and apply it to wider fields. Those results indicate that the thermochemical technique is effective for selecting the solvent for coal liquefaction. (2 figs, 2 tabs, 3 refs)

50402 (FSJ—8601, pp 10-13) **Hydrogen donor ability of the coal liquefaction solvent. Hydrogenation of SRC-2.** Tanabe, Katsumori; Yokoyama, Susumu; Sato, Masaaki; Sanada, Yuzo. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

There is a process for reusing the solvent for coal liquefaction after the hydrogenation process of the reaction product from which heavier fraction is recovered. The main purpose of the hydrogenation process is to improve the hydrogen donating power of the circulating solvent. The optimum operating conditions are the key to the successful operation of the process. The previous papers present the evaluation of the hydrogen donating power of the circulating solvent. This paper presents the high-performance liquid-chromatographical-mass spectroscopical analysis of the reaction product obtained at 360 to 460°C for 30 minutes from the SRC-II heavier fraction using a Co-Mo-Ni catalyst and the variation in the composition of the reaction product. The results indicate that polar substances are decomposed and aromatic compounds are hydrogenated up to 420°C, while it is unpreferable for improving the hydrogen donating power of solvent to increase the reaction temperature higher than 430°C because the cleavage of naphthene ring, dealkylation and dehydrogenation take place exceeding the temperature. (6 figs, 1 tab, 3 refs)

50403 (FSJ—8601, pp 14-17) **Characterization of coal and pitch by means of hydrogen donor ability (Da) and hydrogen acceptor ability (Aa). Effect of pressure, chemical composition and oxidation on Da and Aa.** Takahashi, Naoki; Yokono, Tetsuro; Sanada, Yuzo; Imamura, Takuji. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan; Kawasaki Steel Corp., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

This paper presents the pressure dependence of the hydrogen donor ability (Da) and the hydrogen acceptor ability (Aa) as the parameters specifying the hydrogen transfer in the carbonization reaction of coal and pitch. It is considered that the change of Da by pressurizing is caused by the contact of anthracene as the hydrogen acceptor with the hydrogen donating low-molecular compound to coal-derived tar. Since the low-boiling compounds in tar move from the liquid phase to the gaseous phase under normal pressure, the reaction with anthracene remaining in the liquid phase is insufficient. Since most of the tar remains in the liquid phase and the tar oozing out to the surface of coal forms the film under pressure, it effectively reacts with anthracene and Da is increased. Further pressurizing, the tar is inhibited from coming out to the surface of coal, so the reaction with anthracene is retarded. The change of chemical composition of low-molecular reaction product by pressurizing is considered. (6 figs, 3 refs)

50404 (FSJ—8601, pp 18-21) **Studies on the solvents in coal liquefaction (3).** Masunaga, Toshio; Aiura, Masato; Kageyama, Yoichi; Kawai, Satoshi. (Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The easy transfer of hydrogen as well as the transferable amount of hydrogen is the important indicator of solvent performance in the coal liquefaction process. The measuring method of easy transfer of hydrogen was developed by measuring the inhibiting effect of the solvent added for the pyrolysis of n-tetracosane, n-paraffin, in the nitrogen atmosphere. The pyrolysis of n-tetracosane in the nitrogen atmosphere is inhibited in the presence of a compound with a transferable hydrogen. This is because the radical chain reaction is inhibited by stabilizing the pyrolysis radical of n-tetracosane with the transferable hydrogen. It is possible, therefore, to determine the radical stabilizing effect of liquefaction solvent under the conditions close to the practical ones by measuring the pyrolytic ratio of n-tetracosane in the presence of the liquefaction solvent. This is also a simplified method for the performance indicator of liquefaction solvent. (2 figs, 1 tab, 2 refs)

50405 (FSJ—8601, pp 22-25) **Studies on the solvents in coal liquefaction (4).** Kaneko, Shinji; Masunaga, Toshio; Kageyama, Yoichi; Kawai, Satoshi. (Asia Oil Co., Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The pyrolytic method of n-paraffin was developed as an indicator representing the performance of coal liquefaction solvent. The transferable amount of hydrogen and the easy transfer of hydrogen at a temperature close to the liquefaction reaction temperature can be measured by this method. Especially for HDAO, the pyrolytic ratio of n-tetracosane was measured to study the relationship between the properties and the liquefaction reaction. The results indicate that the aromatic fa which has been used as the indicator is hard to be the indicator for the fraction mainly containing the saturated compounds. Although the transferable amount of hydrogen can be measured by the C^{13}-NMR method, the transfering rate cannot be measured and the measurement is different from the transferable amount of hydrogen in the practical liquefaction reaction. Meanwhile, the pyrolytic method of n-paraffin is a more preferable indicator because the measurement is made under conditions close to the practical ones and the transferable amount of hydrogen and the easy transfer of hydrogen are measured at the same time. (3 tabs, 1 ref)

50406 (FSJ—8601, pp 26-29) **Hydrogenation of the solvent for coal liquefaction (3).** Kuriki, Yasunori; Oshima, Satoshi; Yumura, Motoo; Omori, Takao; Kawamura, Mitsutaka; Yamamizu, Kikuo; Tatematsu, Toshiichi. (New Energy Development Organization, Tokyo, Japan; National Chemical Lab. for Industry, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The liquefied oil obtained in a 0.1 t/d-direct hydrogenation pilot plant was fractionally distilled to apply the solvent to the practical liquefaction and submitted to the investigation of the hydrogenation reaction of solvent. The relationship between the distributive behaviour of solvent by the types of compound and the hydrogenation was investigated as the changes in the reaction conditions and chemical composition in the hydrogenation of solvent. It was confirmed that the fraction containing 100% of n-hexane (Fr-P) prepared by HPLC to investigate the behaviour of saturated hydrocarbons is a fraction mainly containing n-paraffin and that the fractionation by HPLC is valid. Perhydrogenated compounds produced in the reaction wee eluted together with paraffins from Fr-P. n-Paraffins in Fr-P reach the saturation in the beginning of reaction, because n-paraffins are produced by the pyrolysis. (4 figs, 2 tabs, 7 refs)

50407 (FSJ—8601, pp 30-33) **Relation between quantity of hydrogen donor and hydrogenolysis on hydrogen transfer liquefaction of low rank coal.** Mochida, Isao; Yufu, Atsushi; Sakanishi, Kinya; Korai, Yozo. (Kyushu Univ., Research Inst. of Industrial Science, Fukuoka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The effect of the hydrogen donating solvent on the distribution in liquefied product by the hydrogen transfer reaction of Morwell coal using 1, 2, 3, 10b-tetrahydrofluoranthene (4 HFL) under the conditions of high temperature and short contact time was investigated to improve the economics of coal liquefaction process. The result indicates that the yield of oil plus asphaltene in the process at 450°C is 80%. The effect of the concentration of 4 HFL on the yield of gas was determined. Using a solvent prepared by diluting 4 HFL with fluoranthene, the yield of oil plus asphaltene is 6% higher than that using 4 HFL alone though the yield of preasphaltene is slightly higher. This is because the yield of gas does not exceed 12% even by increasing the reaction time by 20 minutes. The yield of gas does not increase using the diluted solvent. This is because the production of hydrocarbon gas is inhibited. (4 figs, 3 tabs, 5 refs)

50408 (FSJ—8601, pp 34-36) **Interaction between coal and hydrogen donor solvent in the preheater (2). Effect of pressure.** Shibata, Masao; Sakaki, Tsuyoshi; Adachi, Yoshio; Miki, Toshiharu; Arita, Seiji. (Government Industrial Research Inst., Kyushu, Saga, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Slurry of coal and solvent is generally fed to the liquefaction reactor through pipe type heat exchangers in the coal liquefaction process. The initial liquefaction reaction proceeds in the heat exchangers by the pyrolysis of coal and the reaction of the hydrogen donating solvent. Changing the pressure in the system keeping the heating pattern of the slurry constant, the interaction between the coal and the solvent in the heat exchangers was examined. Although the heat treatment time at 300 to 450 °C is as short as about 2.6 minutes, the solubilization of coal proceeds considerably, especially the pyridine-insoluble remarkably decrease and the concentration of tetrahydrofluoranthene decreases at the same time. It was found that the decrease of solvent-insolubles, the increase of filtrate viscosity and the decrease of 50% average particle diameter of the degraded coal particles are observed by increasing the pressure and that the pressure affects the initial liquefaction reaction in the heat exchangers. (7 figs)

50409 (FSJ—8601, pp 37-40) **Noncatalyst donor-solvent coal liquefaction on Illinois No.6.** Miyamoto, Yukio; Miyazaki, Junji; Ogo, Yoshiaki. (Osaka City Univ., Faculty of Engineering, Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The solvent hydrogenation liquefaction of Illinois No. 6 coal was simulatively analyzed. The production of BS content from Illinois No. 6 coal is approximately twice that from Wandoan coal, the same bituminous coal as that coal. The reaction profiles of these two coals are different from each other in such a way that the reaction product from Wandoan coal contains predominantly the unreacted coal through preasphaltene, while that from Illinois No. 6 coal contains mainly the unreacted coal through asphaltene as well as the unreacted coal through preasphaltene. Naphthalene produced by dehydrogenation reaction of tetralin, corresponding to the production of BS content, is approximately twice that from Wandoan coal. Meanwhile, the production of 1-methylindan by isomerization increases rapidly at a temperature higher than the critical temperature of 446°C, while that at 400°C is 1% or less under any pressure. The result indicates that the temperature of coal liquefaction reaction is preferable to be the critical temperature of the hydrogen donating solvent or under. (7 figs, 3 tabs, 4 refs)

50410 (FSJ—8601, pp 41-43) **Short contact time liquefaction of coal using binary vehicles.** Okada, Katsuyuki; Kodama, Masaya; Esumi, Kunio; Meguro, Kenjiro; Honda, Hidemasa. (Science Univ. of Tokyo, Faculty of Science, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

A solvent for coal liquefaction requires the abilities of immersion, swelling and dissolution of coal as well as the hydrogen donating power. The swelling of coal was investigated using the solvent system of 1, 2, 3, 4-tetrahydroquinoline (THQ) mixed with ethanol at various ratios. The swelling index of 1.36 for the single solvent of THQ was increased to 1.62 by adding 10 wt% of ethanol. The conversion to BS for adding ethanol to THQ as the hydrogen donor at various ratios reveals that the swelling reaches the equilibrium in 24 hours. The coal was liquefied after leaving to stand in the vehicle for 24 hours from the addition of ethanol. The high conversion was obtained by the addition of approximately 10% of ethanol. The conversion reaches equilibrium after 24 hours in the swelling mixture at normal temperature. The conversion to BS of coal is increased by using the mixture left to stand for 24 hours. (6 figs)

50411 (FSJ—8601, pp 44-47) **Low temperature-long time, high temperature-short time liquefaction of coal (2). Effects of solvent, hydrogen pressure, catalyst and a trial manufacture of micro continuous coal hydrogenation apparatus (60g/h).** Makabe, Masataka; Tsuchida, Yuzo; Ito, Hironori; Ouchi, Koji. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

In order to convert coal to a light oil, a two step coal liquefaction system has been devised, by which the 0 - linkages of coal are cleaved and the aromatic rings are saturated for a low temperature - long time, under low hydrogen pressure with a low active catalyst, and then the saturated C - C linkages are cleaved for a high temperature - short time to avoid coking of the coal. In this study, an attempt to improve the liquefaction rate of the two-step treatment was made. By using a hydrogen- donating solvent for the Wandoan coal, increasing the hydrogen pressure, and using an active catalyst, the total oil yield, particularly, the conversion to light oil could be enhanced. The max. total oil content was about 70%, and the yield of a light distillate obtained up to the reaction temperature of 325°C was 55%. A micro continuous apparatus having a slurry charge capacity of 60 g/h, adopting the two step reaction system, was assembled for bench-scale test. Though some problems such as clogging of the second pipe reactor caused by the sedimentation of solids separated from the liquid component and so on were found, on the whole, results were satisfactory. (5 figs, 1 tab, 5 refs)

50412 (FSJ—8601, pp 48-51) **Estimating method for the equilibrium state in coal liquefaction process.** Hayakawa, Keiichi; Kurachi, Kazuhito; Yao, Tadashi. (Sumitomo Metal Industries Ltd., Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

It is assumed that a solvent composition at the equilibrium produced by coal liquefaction process is a sum of coal liquids derived from coal and hydrocracking products of the coal liquids. In this study, the hydrocracking reaction of solvents and the hydrogenation reaction of the solvents by which the solvents are converted to light oils, in coal liquefaction process were modeled. A model for the hydrocracking reaction of the solvents by which the reaction is taken as a sequential parallel first-order reaction was prepared. The results agreed closely with the experimental results. A model for estimating the recycled solvent fractions at the equilibrium was prepared by combining the above model with a model for the light oil conversion reaction in the solvent hydrogenation process. As a result, estimation of an equilibrium value of the recycled solvents has been possible. Based on the model, the distribution of coal liquefied products of 1 ton/d PDU was estimated, and the heavy oil degree was higher than that of the liquified products by using a 5 liter autoclave. It is supposed that this difference is attributed to the difference in the reactor performance. (4 figs, 3 tabs, 1 ref)

50413 (FSJ—8601, pp 52-55) **Effect of recycle experiment using hydrotreated heavy solvent on the coal liquefaction.** Sato, Yoshiki; Yamamoto, Yoshitaka; Miki, Keiji; Saito, Kunio. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

In order to elucidate effects of recycled hydrotreated heavy solvents on coal liquefaction, the recycle experiment of the Taiheiyo coal was carried out in the following reaction conditions: a; liquefaction reaction (L) at 440°C, b; L at 440°C and hydrotreatment reaction (H) at 370°C, c; L at 440°C and H at 390°C, d; L at 450°C and H at 390°C. For all the reaction conditions, the conversion rates were nearly the same. The oil yield was about 47 wt% for the reaction conditions b - d. The concentration of the tetralin solvent decreased, and the naphthalene yield increased with the recycling progressed. For the reaction condition c, the phenol yield was extremely reduced, as compared with that by the condition a. Further, for the condition c, the naphthalene concentration was reduced to 1/3, and the tetralin concentration increased, as compared with that by the condition a. This means that the reduction reaction of the phenols depends on the hydrotreatment only. (3 figs, 2 tabs, 2 refs)

50414 (FSJ—8601, pp 56-59) **Effect of bottoms recycle on the Taiheiyo and Yallourn coal liquefaction.** Imuta, Kazutoshi; Saito, Ikuo; Sato, Yoshiki. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Examination was made on the bottoms recycle in coal liquefaction process. For the Yallourn coal, the distillate yield increased with the addition amount of SRC increased. The Miike SRC addition was more effective than the Yallourn SRC addition. On the other hand, the Taiheiyo coal exhibited a higher distillate rate than the Yallourn coal, but the SRC addition effect was not found. In fact, the distillate rate decreased with the SRC addition amount increased. For the Yallourn coal, the ratio of distillates/SRC tended to increase with the SRC addition amount increased. This tendency

became remarkable when the Yallourn SRC was added. This means that the Yallourn SRC is a useful solvent for production of distillates. As seen from the relationship between the H/C of the SRC and the distillate rate, the effect of the SRC addition is higher, as the coalification degree of coal raw-material and that of the coal raw-material of SRC to be added are lower. In other words, these coal raw materials are effective in the bottoms recycle process. (4 figs, 2 tabs, 6 refs)

50415 (FSJ—8601, pp 60-63) **Change of character of recycle solvent used for coal liquefaction and production of n-alkanes in it.** Mashimo, Kiyoshi; Nagashima, Takaaki; Kobayashi, Chiaki; Wainai, Toru. (Nihon Univ., College of Science and Tech., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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This paper presents the change of character of recycle solvent used for coal liquefaction and the accumulation of n-alkanes in the solvent. From the liquefaction reaction of Taiheiyo coal by the batch recycle experiment using the hydrogenated, distilled anthracene as the starting solvent, it was found that the yield of lighter fraction, R, in the recycle solvent increased, since the lighter fraction in the hydrogenation solvent increased to produce hydroaromatic compounds with the increase of recycle number. Although R increased till the third recycle, it increased only a little since then because of superhydrogenation of the solvent. This is because the amount of donative hydrogen produced by the hydrogenation of recycle solvent is limited. Although alkanes were accumulated in the recycle solvent, the amount of accumulation was 1% or less even in the fourth recycle. This is because the alkanes produced are removed by using a relatively low-boiling fraction as the solvent. (6 figs, 3 refs.)

50416 (FSJ—8601, pp 68-70) **Studies on the hydrocracking of deashed oil (4).** Kimura, Takao; Koike, Yasuo; Masuyama, Tetsuo; Kageyama, Yoichi; Kawai, Satoshi. (Asia Oil Co., Ltd., Tokyo, Japan; Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal liquefaction Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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A two stage-liquefaction process for the secondary hydrocracking of the deashed oil produced from the primarily hydrogenated Australian coal is being developed using a Mo-catalyst. The previous papers reported the mechanism depositing coke on the surface of catalyst, the development of modified Ca-catalyst for inhibiting the deposition of coke and the effect inhibiting the deposition of coke by this catalyst. Characterizing the structure of catalyst by the sulphurization, aging and reaction of the supporting metal of Ca-Ni-Mo/Al_2O_3 catalyst, it was investigated in this study how Ca participates in the mechanism inhibiting the production of cake-like material. The result indicates that the deposition of coke is inhibited by Ca in the vicinity of active metal Mo, though $CaMoO_4$ produced from Ca and Mo in the fresh catalyst loses the crystallizability by sulphurization and each sulphide is produced. (4 figs, 4 refs)

50417 (FSJ—8601, pp 71-74) **Relation between coalification of raw coal and characteristics of activated carbon.** Yano, Mitsuyoshi; Tatsumoto, Katsunobu; Ida, Shiro. (Mitsui Mining Co., Ltd., Kitakyusyu Coking Works, Fukuoka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The rates of desulphurization and denitrification by activated carbon in the dry desulphurization-denitrification process were 100 and 80%, respectively, in the test carried out at a temperature of 130 to 150°C and SV of 400 to 500 in desulphurization-denitrification plants of 1000 and 3000 m^3/h of exhaust gas. The properties of activated carbon were determined from the changing behaviour of properties of activated carbon in the desulphurization-denitrification process. Activated carbon was manufactured from 11 ranks of coal containing 7 to 43% of volatile matter and the relationship between the coal and the properties of activated carbon was investigated. It was found that the coal containing 34 to 43% of volatile matter was preferable for producing the activated carbon for the desulphurization-denitrification process. The reasons are now being examined. The reasons are now being examined. At any rate, the future problem is to develop the process for manufacturing activated carbon considering the cost of the coal. (2 figs, 1 tab, 7 refs)

50418 (FSJ—8601, pp 75-78) **Characterization of activated carbon for dry DeSOx-DeOX process (3).** Tsuji, Kazuhiko; Aramaki, Yoshinori; Fujino, Hiroshi; Ida, Shiro. (Mitsui Mining Co., Ltd., Kitakyushu Coking Works, Fukuoka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The properties of the activated carbon (AC) used in a dry desulphurization-denitrification commercial plant for treating the exhaust gas at 30,000Nm^3/h had been examined for a long time. The change in properties of AC had the same tendency as that of AC used for a long time in a pilot plant of 1000m^3/h of exhaust gas. The surface area and volatile matter of AC were increased and the denitrification performance was improved in approximately 4000 hours from the start up of operation. Although AC was broken into fine particles during the circulation in the large-sized plant, AC was so much activated that the performance of desulphurization-denitrification was improved. The change of properties of AC including the particle size distribution was stabilized in about a year. The result of FT-IR measurement indicates that the surface of AC is gradually oxidized and the oxygen-containing functional group changes from basic to acidic. (3 figs, 1 tab, 3 refs)

50419 (FSJ—8601, pp 90-93) **Studies on thermoplastic properties of coal under pressure. Mass spectrometric analysis of oxidation reaction of Miike Coal.** Yamada, Osamu; Kaiho, Mamoru; Makino, Mitsunori; Kobayashi, Mitsuo; Yamashita, Yasumasa. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The relationship of the degree of oxidation of Miike coal with the flow properties and the oxidation reaction of it were investigated. The starting temperature of flow in raised and the range of flow is narrowed while the maximum degree of fluidity is exponential decreased as the degree of oxidation increases. These changes depend hardly upon the oxidizing temperature but upon only the degree of oxidation. The coal with the degree of oxidation of 0.66% has the maximum fluidity at approximately 15 atm. The maximum point disappears with the decrease of the degree of oxidation. The degree of fluidity increases monotonously with the pressure. The result of mass spectrometry indicates that the oxidation reaction starts by taking up oxygen onto the surface of coal to release CO in the coal and H_2O, CO and CO_2 are produced and that CO is oxidized with oxygen on the surface of coal into CO_2 and the ratio of CO/CO_2 becomes constant with the the passage of time. (5 figs, 4 refs)

50420 (FSJ—8601, pp 94-97) **Estimation of thermal stress during corbonization.** Fukai, Jun; Suzuki, Kazuya; Miura, Takatoshi; Ortani, Shigemori. (Tohoku Univ., Faculty of Engineering, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The strain increment theory was applied to the shift of the zone to be analyzed with time such as the shift of the crack initiation zone from the coal layer to the coke layer to analyze the crack initiation mechanism in the coke layer in the carbonization chamber of a coke oven and the stress developed in the coke layer during the carbonization was estimated. The effect of the heating

rate or load on the degree of crack initiation was experimentally determined and the relationship of it with the stress obtained from the analysis was examined. The result indicates that the estimated shape of coke layer is convex and the estimation agrees with the actual phenomenon, and that the possibility of crack initiation is high because the tensile stress developed in the coke layer increases with the increase of heating rate and load. Although it is considered from conventional researches that the crack is initiated by the concave shape of coke layer, the shape of it becomes convex at the initial stage of coke formation according to this study. It is a future problem to investigate how this shape of coke layer affects the crack initiation. (6 figs, 6 refs)

50421 (FSJ—8601, pp 98-102) **Analysis of coal gasification with moving bed gasifier.** Kaiho, Mamoru; Makino, Mitsunori; Kobayashi, Mitsuo; Yamada, Osamu; Yamashita, Yasumasa; Fujinami, Shosaku. (National Research Inst. for Pollution and Resources, Ibaraki, Japan; Ebara Corp., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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It is important for improving the efficiency of coal gasification process to understand the properties of the coal and char during the reaction as well as fundamentally elucidate the reactions of O_2, CO_2 and H_2O with coal. A fixed-bed gasifier 250 to 300 mm in I.D. for the basic research was fabricated and a basic experiment of gasification was made using blairthol coal. Various reaction zones were formed in the gasifier though it was small, and the efficiency of cold gas was 63 to 67%. It was found that the gasification is carried out without channeling of gasifying agent though the height of coal layer is decreased to approximately 200 mm and that the properties of tar produced are improved a little. The knowledge is a guideline to the reaction process of coal in the entrained and fluidized-bed gasifiers. The study on the fixed-bed gasifier with high theoretical thermal efficiency will serve the evaluation of the other types of gasifier and the development of new processes. (7 figs, 2 tabs)

50422 (FSJ—8601, pp 103-106) **Analysis of coal gasification with moving bed gasifier (2).** Makino, Mitsunori; Kaiho, Mamoru; Kobayashi, Mitsuo; Yamada, Osamu; Yamashita, Yasumasa; Fujinami, Shosaku. (National Research Inst. for Pollution and Resources, Ibaraki, Japan; Ebara Corp., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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A model of reactions in the coal gasifier was developed to analyze the behavior of gasification in a small moving bed gasifier and the calculated results were compared with the actual results of plant operation using Blair Athol coal. The reactions in the gasifier includes combustion reaction, partial combustion reaction, water-gas reaction, Boudourd reaction, water-gas shifting reaction and its reverse reaction. Comparing the calculated results with the actual results of plant operation, the following results were obtained: the compositions of produced gas agreed with each other; the relative error of the amount of product gas, within -1 and +20%, was not so low; and the temperature distributions were almost equal to each other. The reason why the relative error is not so low will be investigated though it was considered the operation was not always stable because the height of bed of char varied a great deal with time. The comparison of the ash contents of the char remaining in the gasifier after quenching indicates that there seems no problem in the calculated result. The reaction in the gasifier estimated from the model can be argued. (3 figs, 5 refs)

50423 (FSJ—8601, pp 111-114) **Steam gasification of brown coal with sodium catalyst prepared from sodium chloride solution by using the ion exchange method.** Nabatame, Toshihide; Takarada, Takayuki; Otsuka, Yasuo; Tomita, Akira. (Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Sodium was supported on coal using sodium chloride as the starting material by the ion exchange method, and the sodium content and residual chloride in the carrier coal and its reactivity in the steam gasification were examined to study the catalytic coal-gasification using the sodium catalyst. Sodium was supported on coal as follows: Yallourn coal (100 to 200 mesh) was dipped in sodium chloride solutions with different pH values; the stirred mixture was filtered; and the filter cake was washed with demineralized water. The sodium was analyzed by the flame analysis and the chlorine content was determined by the Eschka method. The amount of sodium supported increases with the increase of pH of the catalyst preparation solution. The residual chlorine can be reduced to the same level as that of the feed coal only by washing the carrier coal with pure water. The reactivity of carrier coal of sodium was as high as that of the sodium carbonate-impregnated coal. (2 figs, 2 tabs, 3 refs)

50424 (FSJ—8601, pp 115-118) **TPd and pulse gasification of Na and Na-Fe loaded yallourn char.** Suzuki, Toshimitsu; Inoue, Kazuhikof Nakajima, Seiji; Watanabe, Yoshihisa. (Kyoto Univ., Faculty of Engineering, Koyto, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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TPD and pulse coal gasification by CO_2 were carried out to investigate the reaction mechanisms of the gasification using binary catalyst of Fe-alkali. A sharp peak of CO desorption is observed at a temperature of 750 to 800°C in TPD of Yallourn char and catalyst carrier char. Probably this is because metal oxides in the catalyst or ash are produced from the reduction by the carbonaceous material. Two peaks are observed in the pulse gasification by CO_2. This indicates that the peak of catalytic reduction of metal oxides by carbonaceous material occurs after the main peak. The activity of a catalyst supporting $Fe(NO_3)_3$ alone was almost zero and the iron oxide was hardly reduced by carbon in the steady flow of CO_2. Meanwhile, the iron oxide was reduced by carbon in the presence of Na. It was estimated, therefore, that the binary catalyst has high reactivity for the gasification. (3 figs, 2 tabs, 5 refs)

50425 (FSJ—8601, pp 119-122) **Primary tar and gas evolution during carbonization of coal.** Uno, Takeo; Nishi, Tetsu; Okuhara, Toshiaki. (Nippon Steel Corp., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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In order to control the carbonization reaction product by analyzing the production process of carbonization product in a chamber type coke oven, it is necessary to investigate separating the pyrolysis of coal from the secondary reaction due to the complicated reaction in the oven. A carbonization experiment was made, therefore, using a stainless steel box type model oven 20 mm wide so that the tar produced would not be secondarily decomposed. The result indicates that the double regression equation based on the elementary analysis is superior to the mass balance equation which has been regressed on the basis of the volatile matter so far. In the gas evolution behaviour, the peaks of production of methane and hydrogen and at 500 to 550°C and 700 to 800°C, respectively. The structure of the primary tar seems to be reflected in the chemical structure of coal viewing from the aromatic index and elementary composition. The existence of long chain aliphatic carbon was identified. (7 figs, 3 tabs, 2 refs)

50426 (FSJ—8601, pp 123-125) **Gasification of carbon with steam and hydrogen, using iron catalysts.** Takahashi, Akira; Nishiyama, Yoshiyuki. (Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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An experiment was made to clarify the effectiveness of iron catalysts and the gasification behaviour as part of the research on the catalytic gasification of coal. Granular activated carbon pulverized into 0.5 to 0.25 mm was used as the carbonaceous material. A thermobalance and a gaschromategraph were used for the gasification reaction. The partial pressure of steam was kept at 0.18 atm in the steam gasification and that of hydrogen was kept at 0.81 atm (the remainder is the partial pressure of helium) in the hydrogen gasification. The whole pressure in both processes is 1 atm. The reaction temperature is increased from room temperature up to 850°C at a rate of 22°C/min and maintained at 850°C for 60 minutes. The result indicates that the iron catalyst added to the gaseous phase is effective to the base material the surface of which is oxidized and the catalyst can be densely dispersed by impregnating the iron catalyst in a hydrophilic substance and that CO_2 is mainly produced in the steam gasification using the iron catalyst. A synergistic effect of a nickel-iron composite catalyst was observed in the steam gasification. (5 figs, 1 tab, 1 ref)

50427 (FSJ—8601, pp 126-129) **Study on steam gasification mechanism of coal char using TPD technique.** Kyotani, Takashi; Zhang, Zhan-Guo; Hayashi, Shigetoshi; Tomita, Akira. (Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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It is considered that the steam gasification of coal proceeds in such a way that the oxygen atoms in the steam are taken up to the surface of coal and the oxygen-containing surface compounds located there become intermediates. The TPD technique is effective for examining the surface compounds. The TPD pattern of the oxygen-containing gas produced from char by the steam gasification was studied by the experiment using three ranks of coal and their deashed ones to clarify the effects of ranks of coal and mineral matters on the types and quantities of the surface compounds. TPD of the oxygen-adsorbing sample used for measuring the activated surface area was made and the relationship between them and the relationship between the quantity of surface compounds and the reactivity of gasification were also investigated. The result indicates that the mineral matters in the char participate in the evolution of gas because most of relatively sharp peaks of CO_2, CO and H_2O in the TPD pattern disappear by deashing. (2 figs, 2 tabs, 1 ref)

50428 (FSJ—8601, pp 130-132) **Nickel catalyzed low temperature gasification of graphite in carbon dioxide. Activity appearance of natural graphite by pretreatments.** Yamada, Tetsuo; Tomita, Akira; Suzuki, Tsutomu; Honma, Tsuneyuki. (Kitami Inst. of Technology, Hokkaido, Japan; Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since a small quantity of sulphur contained in graphite affects the catalytic activity of Ni in the low-temperature gasification of graphite using a Ni-catalyst, the heating and and treatment before the gasification and the addition of sulphur scavenger were investigated to eliminate the effect by sulphur. Although the addition of sulphur scavenger such as Na_2O, $Ca(NO_3)_2$ and $Mn(NO_3)_2$ hardly affects the gasification of graphite, the sulphur content in graphite is decreased and the conversion in the region of low temperature gasification is increased by the heating and NHO_3-treatment. The NHO_3-treatment is efficient especially for increasing the low-temperature gasification activity of coal char as well as natural graphite. The HNO_3- treatment seems not only to be effective for the uptake of sulphur but also to have the secondary effect showing good dispersion of the catalyst by introducing the functional group such as-COOH and-OH derived from the oxidation of carbonaceous material. (1 figs, 3 tabs, 6 refs)

50429 (FSJ—8601, pp 133-136) **Gasification reactivity of various coals at a high temperature.** Hashimoto, Kenji; Miura, Koichi; Xu, Ji-Jun; Yamada, Yoshikuni. (Kyoto Univ., Faculty of Engineering, Koyto, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Eighteen ranks of coal and the coal deashed by acid-(hydrochlonic acid and hydrofluoric acid) treatment were used for the experiment to investigate the factors governing the gasification reaction of coal at a temperature as high as 1000°C or over. A thermobalance type reactor possible to rapidly increase the temperature was used as the gasifier. The gasification rate was measured gasifying by steam and carbon dioxide at 1185°C. The relationships of the gasification rate with the coal rank, C(%), the pore surface area of char, the size of a crystal of carbon and the amount of oxygen taken up by the char were investigated. The result indicates as follows: the gasification activities of coal vary according to the ranks of coal; the gasification rate decreases with the increase of coal rank representing the structure of graphite of carbon; and the amount of oxygen taken up to the surface is closely related to the rate of gasification independent of the effect of catalytic action. (9 figs, 1 tab, 4 refs)

50430 (FSJ—8601, pp 137-140) **Basic study on fusibility of coal ash (2). Investigation on eutectic texture.** Ninomiya, Yoshihiko; Asami, Masahiko; Miyauchi, Tsunekazu; Hirato, Mitsuho. (Tokyo Univ. of Agriculture and Technology, Faculty of Technology, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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It is necessary for discharging the coal ash disturbing the operation of gasifier from the system as slag to establish the control technology of the fusion temperature of ash. The addition of a small quantity of flux to coal has been studied as a measure for the problem. The fusion behaviour of coal ash in the presence of CaO and Fe_2O_3 fluxes and the relationship of fusion temperature drop with the eutectic texture were investigated. A high-temperature type heating stage possible to heat up to 1750°C was used in combination with an optical microscope for the experiment. The result indicates that the effect according to the ranks of coal can be mitigated by adding 0 to 30 Wt% of CaO flux and 20 to 50 Wt% of FeO flux to the coal ash because the fusion temperature decreases to 1100°C or under. It was estimated from the observation by the microscope combined with the heating stage that the fusion reaction begins at about 920°C and the coal ash forms local eutetic texture. (7 figs, 1 tab, 2 refs)

50431 (FSJ—8601, pp 141-144) **Rheological behavior of coal-solvent slurry at high temperature and pressure.** Tsutsumi, Atsushi; Yoshida, Kunio. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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It is necessary for designing the optimum coal liquefaction plant to accurately determine the physical properties of coal-solvent slurry such as viscosity, density and heat conductivity. The viscosity of the coal-solvent slurry was measured at high temperature under high pressure in a wide range of shear rate by a capillary viscometer. The relative viscosity of the coal-solvent slurry is increased by the swelling of coal particles derived from the absorption of solvent at a temperature range from 413 to 493K. The coal is extracted at a temperature of 530K or over and the coal particles are coagulated by the crosslinking of colloidal substance produced. Strong pseudoplasticity is, therfore, developed by the increase of non-Newtonian behaviour accompanied by the increase of viscosity. At a temperature of 957K or over, the viscosity is rapidly decreased by the disintegration of coagulation structure. Successively, the viscosity is further decreased by the extractive decomposition and dissolution of coal particles. (4 figs, 1 tab, 8 refs)

50432 (FSJ—8601, pp 145-148) **Change of apparent viscosity of coal/tetralin slurry during liquefaction.** Deng, Chaoran; Moritomi, Hiroshi; Sanada, Yuzo; Chiba, Tadatoshi. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The effects of liquefaction product, solvent and ranks of coal on the apparent viscosity of coal/tetralin slurry in the liquefaction of coal by tetralin had been studied. In this experiment, the peak of viscosity observed during the heating was examined. The total weight of the coal sample and the solvent was adjusted to 20 g. The mixture was put in an autoclave which was pressurized with hydrogen up to 10.1 MPa and then heated up to 723K. The autoclave was kept at the temperature for 10 minutes and cooled down at a rate of 10K/min. The experimental result indicates that the sharp increase of viscosity during the heating corresponds to the increase of quinoline-soluble and benzene-insoluble fraction on the surface of coal particle at the time when the percentage of that fraction in the benzene-insubles is about 40 Wt% or more and the difference in the solubility parameters between that fraction and the solvent is about 2 $(cal/cm^3)^{1/2}$ or more. (6 figs, 2 tabs, 2 refs)

50433 (FSJ—8601, pp 149-151) **Operation of coal slurry heater/estimation of slurry viscosity by (d)P cell.** Yokoyama, Kei, Takenaka, Jyoichi; Maeda, Akihiro; Toma, Ichiro. (Nippon Kokan K. K. Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The continuous operation (Run 900) of a 2.4 t/d-coal liquefaction process development unit is being conducted to support the design of the preheating process in a 250 t/d-bituminous coal liquefaction pilot plant. An experiment was made to determine the viscosity of coal slurry during the heating by the reverse calculation of pressure drop measured by a differential pressure gauge ((d)P cell) fitted to a tube in the slurry preheater. In the operation of Run 900, the differential pressure of the fluid in the tube was measured to determine the effective viscosity (viscosity used for calculating the pressure loss). The experimental result indicates that the highest calculated value of the effective viscosity of a 36.67% slurry is about 260 cm poises which is lower than the value generally considered. The values of the effective viscosity was compared with the data obtained by a high-temperature, high-pressure viscometer. (4 figs, 1 tab)

50434 (FSJ—8601, pp 167-170) **Fundamental investigation for pretreatment of coal liquefaction.** Ogino, Keizo; Abe, Masahiko; Kawano, Shin'ichi; Shimizu, Kiyoyuki; Honda, Hidemasa. (Science Univ. of Tokyo, Faculty of Science and Technology, Tokyo, Japan; Science Univ. of Tokyo, Faculty of Science, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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This paper presents the effects of various alcohols, the interaction of coal with liquefaction solvent and the effects of water-content on the swelling of coal in the pretreatment of coal liquefaction. An experiment was made to examine the interactions of various ranks of coal with polar liquid such as methanol and water, non-polar liquid such as hexane, tetralin and benzene, and various alcohols. The result indicates that especially the coal with lower rank of coalification is swollen generating high swelling heat by methanol penetrating the coal more deeply than alcohols with larger number of carbon atoms, water and non-polar liquid. The effect of a mixed solvent of tetralin and methanol on the swelling of coal is larger than that of each single solvents and it is more marvelous as the rank of coalification becomes higher. The liquefaction efficiency of coal with lower rank of coalification is improved by pretreating with methanol or liquefy with a mixed solvent. (5 figs, 3 tabs, 3 refs)

50435 (FSJ—8601, pp 171-174) **Coal cleaning for liquefaction (6). Pretreatment of coal by iron sulfate.** Akiyama, Masaru; Otaka, Yasuo; Matsuo, Kiyotaka; Matsui, Shigeru. (Sumitomo Coal Mining Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The coal liquefactivity and economics had been improved so far by pretreating coal according to various cleaning methods to remove inert components and minerals. In this experiment, the removal of Ca and Mg causing the deposition of carbonates in the reactor with iron sulfate and the liquefactivity of the coal pretreated with iron sulfate were investigated. The 100 mesh or less - sample coal and that pretreated with iron sulfate aqueous solution were submitted to the liquefaction test. The test result indicates that the pretreatment with iron sulfate is an effective method for removing Ca and Mg in coal, especially for low rank low coalification coal with high content of oxygen, and Fe is so much substituted for Ca and Mg in coal by the treatment with iron sulfate that the liquefactivity is improved by the catalytic effect of it. (2 figs, 2 tabs, 6 refs)

50436 (FSJ—8601, pp 175-178) **Effects of pretreatment by organic reduction on coal liquefaction (3).** Yuzu, Satoshi; Fujimoto, Tatsuya; Miyake, Mikio; Nomura, Masakatsu. (Osaka Univ., Faculty of Engineering, Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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In this experiment, Akabira coal pretreated by the reductive hydrogenation was liquefied using the red mud-sulfur (ratio by weight: 9/1) catalyst to determine the effect of the partial reductive hydrogenation as the pretreatment on the coal liquefaction. The reduced coal was prepared by the reductive hydrogenation using sodium in liquid ammonia or by the pretreatment using molten potassium under reflux of tetra-hydrofuran. A 50 ml-autoclave was used for the liquefaction. The result indicates that hydrogen is introduced into the aromatic nucleus in the molecule of coal by the partial hydrogenation and the partial cleavages of C-C and C-O bonds in the structure of coal take place. Since the liquefaction of partially hydrogenated coal is accelerated by introducing hydrogen, the consumption of hydrogen is reduced and the efficiency of reaction is enhanced. (4 figs, 2 tabs, 3 refs)

50437 (FSJ—8601, pp 179-182) **Liquefaction behavior of transalkylated coal.** Kumagai, Haruo; Yokono, Tetsuro; Sanada, Yuzo. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The dissolving power for carbonaceous material during the reaction and the hydrogen-donating power for hydrogenation and hydrocracking of carbonaceous material are required for the coal liquefaction solvent. In this experiment, the liquefaction behavior of the coal chemically modified by transalkylation in the presence of a strong acid catalyst was investigated. Taiheiyo coal was used for the sample coal and 9,10-dihydroanthracene (9,10-DHA) with high hydrogen-donating power was used as the receptor of alkyl group. The experimental result indicates that the incremental hydrogen given by 9,10-DHA introduced into the molecule of coal by transalkylation contributes to the stabilization of radicals produced by the thermal cracking in a higher temperature region. The transalkylation is, therefore, an effective function as the hydrogen donor in the coal liquefaction. It was found that the modification of coal by transalkylation is an effective pretreatment of the coal liquefaction. (4 figs, 2 tabs, 3 refs)

50438 (FSJ—8601, pp 183-186) **Relationships between the properties of low rank coals and their liquefaction potentials (2). Multiple regression analysis.** Kanbayashi, Yutaka; Okada, Kiyoshi; Saito, Kazumoto; Miwa, Tsunahisa; Ikari, Masao; Oosawa, Yoshihiro. (Coal Mining Research Centre, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The relationship between the coal properties and the hydrogenation characteristics was statistically analyzed by the multiple regression analysis to estimate the potential for the liquefaction. Thirty-two ranks of coal ranging from brown coal to high-volatile bituminous coal were used for the experiment and three factors including the factors of rank of coalification, composition and composite were examined. Multiple regression analysis was made combining these three factors. The result indicates that the yields of asphaltene and oil plus asphaltene and the conversion to benzene among the liquefaction characteristics are accurately estimated and the analysis is effective for the estimation of the yield of coal liquids. Since the factors representing the coal properties can be simply analyzed and the automatic analysis is being tested, the analysis will be applied to the routine quality control of feed coal and coal liquids and the yield control in the plant operation. (3 figs, 1 tab, 1 ref)

50439 (FSJ—8601, pp 187-190) **Studies of coal liquefaction (51). Partial oxidation of coals and liquefaction.** Ogata, Eisuke; Okada, Hitoshi; Kamiya, Yoshio. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The partial oxidation reaction of different ranks of coal with pure oxygen and the coal liquids derived from the liquefaction of the partially oxidized coal were investigated. Yallourn, Taiheiyo and Akabira coal were used for the experiment. The partial oxidation of coal with oxygen and the heat treatment in argon were carried out in a 600 ml-glass closed circulation reactor. The experimental result indicates that the rate of consumption of oxygen in the partial oxidation is high at the beginning of reaction and drops with the progress of oxidation reaction to less than a half the initial rate at a time when the consumption of oxygen reaches approximately 30 wt% of that required for the perfect oxidation and that the rate varies according to the ranks of coal. It became clear that the coal liquids derived from Akabira coal taking up the largest amount of oxygen in the liquefaction of partially oxidized coal have a major influence on the content of preasphaltene. (7 tabs)

50440 (FSJ—8601, pp 191-194) **Evaluation of solvent in coal liquefaction kinetics.** Nagaishi, Hiroshi; Moritomi, Hiroshi; Sanada, Yuzo; Chiba, Tadatoshi. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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An experiment was made using a pure solvent such as tetralin and naphthalene to evaluate the complicated effect of solvent in the coal liquefaction process, and the hydrogen donating power of solvent and the production reaction of inert compounds were investigated. The liquefaction experiment was made mainly using Taiheiyo coal at 723K under 10.1 MPa in the nitrogen atmosphere. The result indicates that the production reaction of the pyridine-solubles is formulated in a second-order reaction of the concentration of tetralin in a mixed solvent of tetralin and naphthalene when it is approximately 0.1 or more, but the reaction is not affected by the concentration of tetralin when it is approximately 0.4 or more. When the concentration of tetralin is 0.1 or less, the production reaction of semicoke predominates. It was found that it is necessary for evaluating the coal liquefaction solvent to take the amount of transferable hydrogen in solvent, the hydrogen donating power as well as the production of semicoke largely depending upon these factors into consideration. (5 figs, 2 tabs, 4 refs)

50441 (FSJ—8601, pp 195-198) **Quantitative evaluation of donor-solvent concentration and retrogressive reaction during coal liquefaction.** Moritomi, Hiroshi; Nagaishi, Hiroshi; Sanada, Yuzo; Chiba, Tadatoshi. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The coal liquefaction was analyzed based on a second-order reaction model formulated by adding the term of the concentration of hydrogen to the generalized reaction model which can simulate the liquefaction and retrogressive reactions. A simulation model developed by adding the retrogressive reaction from asphaltene and that from preasphaltene to the semicoke producing reaction so as to handle any extreme reaction system was used. Since the retrogressive reaction is progressed by the polymerization of the reaction products with each other and with the other products, the reaction was assumed as a second-order reaction considering the consistency of the data. The result of the reaction model simulation indicates that the contribution of hydrogen-donating solvent to the liquefaction and retrogressive reactions and that of indirect transfer of hydrogen through the catalyst can be quantitatively evaluated. (4 figs, 2 tabs, 4 refs)

50442 (FSJ—8601, pp 199-202) **Initial behaviour of coal macerals during hydrogenation.** Okada, Kiyoshi; Kanbayashi, Yutaka; Saito, Kazuki; Miwa, Tsunahisa; Ikari, Masao; Osawa, Yoshihiro. (Coal Mining Research Center, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The initial behaviour of three coal maceral groups, exinite, vitrinite and inertinite, during the coal liquefaction was investigated to clarify the relationship between the compositional features by the ranks of coal and the liquefactivity. The investigation is important for selecting the coal for liquefaction. Taiheiyo, Wandoam and River King coals were used for the experiment. The experimental result indicates that degradinite in Taiheiyo coal, sperinite in Wandoan coal and gelocollinite in River King coal are selectively liquefied at lower temperature than vitrinite mainly contained in these coals, and that those macerals and maceral types are positive parameters for estimating the yield of liquefaction, while the amount of inertinite selectively liquefiable at higher temperature is a negative parameter. (1 figs, 1 tab, 5 refs)

50443 (FSJ—8601, pp 203-205) **Studies on initial stage of brown coal liquefaction.** Aiura, Masato; Kageyama, Yoichi; Watanabe, Masato; Kawai, Satoshi. (Mitsubishi Chemical Industries Co., Ltd., Tokyo, Japan; Asia Oil Co., Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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A liquefaction experiment was made using the liquefied oil of brown coal obtained in PDU as the solvent to examine the initial behavior in the brown coal liquefaction. The experiment was carried out using morwell brown coal in a 51-autoclave provided with baffle plates and an electromagnetic induction stirrer into which hydrogen is continuously blown at a rate of 900 Nl/hr.

50444 (FSJ—8601, pp 206-208) **Studies on coal liquefaction (49). Additive effect of SRC on the hydrogenolysis of 1,1′-dinaphthylmethane and 2,2′-dinaphthyl ether.** Koyanagi, Seiya; Futamura, Shigeru; Kamiya, Yoshio. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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SRC produced in the initial stage of coal liquefaction accelerates the hydrogenolysis of model compounds related to coal. In this experiment, the hydrogenolysis of 1,1'-dinaphthylmethane (DNM) and 2,2'-dinaphthylether (DNE) was made in tetralin containing SRC fractioned by column chromatography. The reaction mechanism of SRC was investigated by evaluating the amount of production of 1-methylindane derived from the solvent and the change of structure of SRC caused by the reaction. A 90-ml autoclave provided with an electromagnetic stirrer was used for the experiment. The experimental result indicates that SRC plays a role of shuttler of hydrogen mainly donated from tetralin though the hydrogenolysis of DNM and DNE in tetralin is accelerated by the addition of SRC. (2 figs, 5 tabs, 1 ref)

50445 (FSJ—8601, pp 209-212) **Fundamental study on the distillation of brown coal liquefaction products.** Masuda, Kaoru; Hirano, Tatsuo; Okuma, Osamu; Saito, Kaizaburo; Nakako, Yukio. (Kobe Steel Ltd., Chemical Industry Research Center, Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since the relationship between the boiling point of the product obtained by the gaschromatic distillation and the relation time, calibration curve of boiling point, varies according to the structure of material, the calibration curve appropriate to the features of liquefied oil is required. In this experiment, the calibration curve of boiling point was investigated to apply to the gaschromatic distillation to the liquefied oil of brown coal. The result indicates that a calibration curve of aromatic compound can be applied to the high-aromaticity primary hydrogenated oil, but another calibration curve is required for the secondary hydrogenated oil which contains a lot of hydrogenated materials. Since it was understood how to formulate the correlation in the hydrogenated material and alkyl substitution product between the boiling point and the retention time, the formulation will be developed. It was found that the accuracy of fractional distillation of liquefied oil to the properties of liquefied oil with the accuracy of fractional distillation must be studied. (5 figs, 3 refs)

50446 (FSJ—8601, pp 213-215) **Separation of benzene insoluble matter from coal liquefied products.** Niho, Yuko; Kodama, Masaya; Esumi, Kunio; Meguro, Kenjiro; Honda, Hidemasa. (Science Univ. of Tokyo, Faculty of Science, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Adding an anti-solvent to the benzene-diluted dispersion of the benzene-insolubles (BI) in the product obtained by liquefying coal with 1, 2, 3, 4 - tetrahydroquinoline at 420°C for a period as short as 30 minutes in an autoclave, the solids were separated from the liquids by the gravitational sedimentation method. In this experiment, the effect of the anti-solvent on the separation of BI from the liquids in the system containing benzene-solubles (BS) was investigated. The result indicates that the addition of n-alkane as the anti-solvent is effective for the separation of solids from the system containing BS, while the addition of a W/O emulsion with a surfactant has no influence in a system containing BS. (4 figs, 3 tabs)

50447 (FSJ—8601, pp 216-219) **Studies on multivariate analysis of various coal liquefaction test results by 0.1t/d bench plant.** Narita, Hideo; Hasegawa, Yoshihisa; Yoshida, Ryoichi; Yokoyama, Shin'ichi; Yoshida, Tadashi; Fukuda, Takashi; Idogawa, Kiyoshi; Maekawa, Yosuke. (Government Industrial Development Lab., Hokkaido, Sapporo, Japan; New Energy Development Organization, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Multivariate analysis was applied to the investigation of the factors affecting the coal liquefaction such as ranks of coal, catalyst, properties of medium and operational conditions of the reaction based on the test results of a 0.1 t/d-bench plant. The analysis of main components was made based on the results of 150 runs of test. The effects of operational conditions such as medium (six), catalyst (five), temperature and pressure on the liquefaction reaction of Taiheiyo coal alone was examined by the quantitative analysis. The information on coking was acquired from the consumption of hydrogen and the yield of hydrocarbon gas derived from the analysis of main components and the relationships of the yield of gas with the medium and pressure were clarified by the quantitative analysis. Since the multivariate analysis alone does not necessarily acquire the physical meaning for the coal liquefaction reaction, the systematic acquisition of data will be required for the plant design, and analysis and rationalization of liquefaction process. (8 figs, 3 tabs)

50448 (FSJ—8601, pp 224-226) **Studies on the thermal behavior of vacuum bottom oil from coal liquefaction process (2).** Kurachi, Kazuhito; Hayakawa, Keiichi. (Sumitomo Metal Industries Ltd., Osaka, Japan). 23 Oct 1986. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The effect of the thermal change of properties on the distillation was investigated by the experiment using the bottom slurry of the gas-liquid separating column in a 1 t/d coal liquefaction PDU. The experimental result indicates that n-heptane-solubles (HS) and n-heptane-insoluble-toluene solubles (HI-TS) decrease, while toluene-soluble organic matter (TI) increases as the time of thermal change of properties at 330°C is increased. The result of the study on the temperature of thermal change of properties indicates that HS decreases but TI-QS increases as the temperature is raised in the same manner as the time of thermal change of properties. The slurry with the thermally changed properties was simply distilled at 360°C under vacuum. The result indicates that the amount of simple distillate decrease with the increases of the time and temperature of thermal change of properties, so the effect of thermal change of properties is observed. (5 figs, 1 tab, 3 refs)

50449 (FSJ—8601, pp 227-230) **Studies on the polymerization reaction of the coal liquids (3).** Ikari, Kenji; Masuyama, Tetsuo; Kageyama, Yoichi; Kawai, Satoshi. (Mitsubishi Chemical Industries Ltd., Tokyo, Japan; Nippon Brown Coal Liquefaction Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The causes of polymerization reaction of the coal liquids include two processes, the production of heavier molecules, and the coagulation and deposition of these heavier molecules. This paper presents the deposition process in the latter. A 20 ml-microcylinder for measuring solubility was used for the experiment of deposition of insoluble matter. The experimental result indicates that the dissolving power of the solvent largely affects the deposition of heavier matter such as BIETHFS and THFIEPS and that the deposition decreases by higher dissolving power with the increases of nitrogen content as the index of solvent properties and of aromaticity. As a result, it is considered important for designing the coal liquefaction solvent to investigate the stability of operation as well as the performance of reaction. (5 figs, 3 refs)

50450 (FSJ—8601, pp 231-233) **1 ton per day PDU operation for NEDOL process.** Kiritani, Yoshinobu; Echigo, Hiroyuki; Yamamoto, Zen'ichi; Yamada, Takehiko. (Sumitomo Metal Industries Ltd., Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The demonstrative operation on the NEDOL coal liquefaction process by a 1 t/d-PDU was carried out using Wandoan coal, australian subbituminous coal, as part of the research entrusted from New Energy Development Organization (NEDO). The Experiment by the PDU was made in such a way that the recycle solvent was hydrogenated in advance after the sulfurization of the sol-

vent hydrogenation catalyst (commerically available Ni-Mo catalyst). The hydrogenated solvent heated up the liquefaction system and then the solvent was replaced by slurry. The result of the demonstrative operation indicates that the conditions for obtaining 50% daf or more of the yield of coal liquieds on the basis of NEDOL mode coals be confirmed and the yield by coal liquids reached 50% under the conditions of the basic design of a 250 t/d-pilot plant and that the properties of recycle solvent became almost equilibrium and the concentration of heavier oil before the hydrogeneration of solvent and fa became stable at approximately 30% and 0.47, respectively. (2 figs, 5 tabs)

50451 (FSJ—8601, pp 234-237) **Liquefaction of Victorian brown coal (6). Liquefaction behavior in continuous stirred tank reactors in series.** Yanai, Shun'ichi; Okuma, Osamu; Murakoshi, Koji; Saito, Kaizaburo; Nakako, Yukio. (Kobe Steel Ltd., Chemical Industry Research Center, Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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It is important for optimizing the operation and process of the commercial plant of coal liquefaction to clarify the process behavior in each reactor of the liquefaction process. The yield and properties of the reaction product in each reactor were examined by liquefying Victorian brown coal in the primary hydrogenation PDU comprising three continuous reactor tanks connected in series. The experimental result indicates that the production of H_2O and $CO+CO_2$ is almost completed and most of the coal liquids are produced in the first reactor and that the conversion of CLB to oil predominated in the second and third reactors. The decrease of the yield of CLB with time is mainly caused by the decrease of BI-PS. The reaction mechanism of heavier matters depends upon the quality of solvent. It is considered, therefore, that the total amount of hydrogen transferred to product, H(t), is varied and the same time the yield of coal liquids is affected by the variation of reaction mechanism. (5 figs, 4 tabs, 3 refs)

50452 (FSJ—8601, pp 238-240) **Liquefaction characteristics of Canadian coal on 0.1t/d continuous coal liquefaction bench plant test.** Maekawa, Yosuke; Hasegawa, Yoshihisa; Yoshida, Ryoichi; Yokoyama, Shin'ichi; Yoshida, Tadashi; Narita, Hideo; Fukuda, Takashi; Idogawa, Kiyoshi. (Government Industrial Development Lab., Hokkaido, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since even the liquefaction characteristics of the same rank of coal are different from each other, ten samples (different sampling positions) of five similar ranks of Canadian coals were liquefied in a 0.1 t/d-bench plant to compare the results with each other. The test result indicates that the reaction rate and yields of coal liquids and gas are much different from each other. It was found that the liquefactivity of Battle River coal was the highest viewing from the reaction rate and yield of coal liquids and that the liquefactivity of the same rank of coal varies according to the sampling position even in the same coal bed. Since there is no close correlation of the liquefactivity with the elementary analysis, technical analysis and aromaticity, the correlation between the chemical properties and the reactivity must be further studied by measuring the chemical properties in detail. (3 tabs)

50453 (FSJ—8601, pp 241-244) **Gas hold-up of a coal liquefaction reactor.** Ishibashi; Hirohito; Yokoyama, Kei; Sakai, Naohide; Ogawa, Takashi. (Nippon Kokan K.K., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since it is important for designing the reactor for coal liquefaction to acquire the knowledge of the fluid characteristics in the reactor, the holdup of gas in the reactor of a 2.4 t/d coal liquefaction PDU was measured. Three methods, gas shut-off method, gas spurge method and neutron attenuation method, were used as the measuring method in the experiment. The PDU comprises a horizontal spiral heater of coal slurry and three reactor columns connected in series. The products from naphtha to heavy oil can be separately recovered. It is, therefore, easy to acquire the knowledge for the scale-up. The experimental result indicates that the data by those three methods agree with each other and that the holdup of gas increases with the increase of pressure, but it hardly depends upon the pressure under 130 kg/cm^{2}G or over. The holdup of gas approaches a constant value at a linear velocity of gas of 4.0 cm/s or more in the operations of coal liquefaction and hot oil. (6 figs, 2 refs)

50454 (FSJ—8601, pp 245-248) **Direct sampling of coal-derived liquid from 2.4t/d PDU reactors.** Ogawa, Takashi; Miyazawa, Kunio; Toma, Ichiro; Maeda, Akihiro; Sakai, Naohide. (Nippon Kokan K.K., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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A direct sampling device from the inside of reactor of a 2.4 t/d-coal liquefaction PDU was developed. A total of four samples was taken for measuring the variation of solid content in the reactor during the liquefaction operation. The sampling is made in such a way that the liquefied oil is put into a sample receiver tank by operating a value of the sampling nozzle and the pressure of the sample receiving tank is gradually decreased to send it to the slurry tank. The experimental result indicates that the ash content in the reactor increases with the increase of the concentration of coal slurry from the startup of operation and it approaches a constant value of approximately 9%. No solid matter was settled in the reactor after the stop of operation. There was no distinguished difference in the content of asphaltene in the samples taken from the inside of reactors between the reactors. (10 figs, 2 refs)

50455 (FSJ—8601, pp 249-252) **Chemical structure of liquid obtained by the mild hydrogenation of Taiheiyo coal (6).** Kato, Takashi; Ito, Hironori; Ouchi, Koji. (Hokkaido Univ., Faculty of engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The oil obtained by mild hydrogenation is separated and analyzed to examine the chemical structure of coal. The polar component predominating in the basic, acidic and neutral distillates was analyzed by the hydrogenation and dehydrogenation followed by GC, GC/MS and FI/MS. The result indicates that the polar content decreases in the order from DS01 through DS06 in phenol and tetralin (indanol) with the increase of boiling point and the polar content increases in the same order as that in -140 and -160. DS-03 is the maximum in -100. On the whole the content of polar component decreases with the increase of Z-number up to -160 and -180. The polar contents are the largest in -60 and -80, phenol and tetralin, and the sum total of it in the two systems accounts for more than a half (approximately 12 wt% in the oil). A considerable amount of nitrogen-containing compounds are also contained in the polar content. (3 figs, 2 tabs, 1 ref)

50456 (FSJ—8601, pp 253-256) **Structural analysis of heavy distillate (oil fraction) derived from brown coal by HPLC and FD/MS methods.** Okazaki, Keishin; Takeshita, Yasuhiro; Tachibana, Shigeo; Saito, Kaizaburo; Nakako, Yukio. (Idemitsu Kosan Co., Ltd., Tokyo, Japan; Kobe Steel Ltd., Chemical Industry Research Center, Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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It is necessary to determine the properties of heavy distillate (CLB; boiling at 420°C or higher) obtained in the primary hydrogenation and that obtained in the secondary hydrogenation because these distillates are circulated in the two-stage liquefaction of Australian brown coal. Separation and preparation were made by HPLC and the prepared samples were analyzed by FD/MS to obtain the structure of n-hexane solubles in CLB. The result of reversed phase chromatography indicates that polycyclic aromatic hydrocarbons (PAH) can be separated according to the degree of hydrogenation of aromatic ring and the number of alkyl-substituting groups. It is considered that the structure of the n-hexane solubles in not a random structure composed of multi-components, but a structure composed of several PAH (tetra-to penta-cyclic) including pyrene (mass number: 202), their partially hydrogenated ring compounds and alkyl-substituted compounds. (7 figs, 2 tabs)

50457 (FSJ—8601, pp 257-260) **Chemical structure of coal-derived oil by HPLC-GC/MS method. Boiling point distribution of the hydrocarbon compound types.** Sato, Masaaki; Yokoyama, Susumu; Sanada, Yuzo. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Distribution simulation of hydrocarbons in the coal-derived oil was made using HPLC-GC/MS to divide into fractions boiling in every 10°C range. The compound type analysis by Z-number was applied to these fractions to draw the composition-boiling point distribution diagrams. The difference in the boiling point distribution of the component among five ranks of coal was examined using the diagrams. The difference is more noticeable in bicyclic aromatics (Fr-D) and polycyclic (tricyclic or more) aromatics (Fr-T) with the decrease of Z-number, or with the increase of the number of naphthenic or aromatic ring. Compounds with small Z-number contain more high-boiling substances than low-boiling substances with the increase of the rank of coalification. The relationship between the boiling point and the average number of carbon atoms in alkyl group in the side chain of Fr-D and -T hardly depends upon the ranks of coal. (4 figs, 2 refs)

50458 (FSJ—8601, pp 265-268) **Chemical structure of polar components in coal-derived liquid.** Sugimoto, Yoshikazu; Miki, Yasuo; Yamadaya, Shoko; Oba, Masaaki; Niwa, Yoshio. (National Chemical Lab.for Industry, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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A method for analyzing the non-polar components (NP) in the coal-derived liquid by hydrocracking and a method for silylizing the polar components (Po) separated by GPC were investigated to determine the chemical structures of heavier Pos in coal-derived liquid. The hydrocracking of Pos and asphaltene (As) was made using a Ni-Mo-Al_2O_3 catalyst at 350°C under the initial pressure of hydrogen of 80 kg/cm² in a 30 ml-autoclave. The experimental result indicates that Pos and As are estimated to have the same skeletal structure because NPs in the hydrocracked oils of Pos and As give similar spectra. A method for shifting the molecular weight of a compound with OH group by finely fractioning according to molecular weight by GPC and silylizing the fractions was investigated. It was found by the silylization that few compounds having two OH groups or both N and OH group in a molecule were contained in the coal-derived liquid. (6 figs, 3 tabs)

50459 (FSJ—8601, pp 269-272) **Structural analysis of coal derived products obtained by the new alkylation method.** Yoneyama, Yoshiharu; Yamamura, Yutaka; Ueno, Kiyoshi; Sugie, Shinji; Kato, Tsutomu; Tsukashima, Hiroshi. (Toyama Univ., Faculty of Engineering, Toyama, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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An experiment was made to elucidate the resolubility-to-benzene of the products obtained by retreating the benzene-insolubles (BIS) and benzene-solubles (BS), the cracking by the retreatment, and the molecular weight distribution and structural characteristics of soluble matters. This paper presents the knowledge acquired by the experiment. Yubari and Taiheiyo coals were used for the experiment. The experiment was carried out in such a way that nitrogen was blown into a three-necked flask containing the sample coal, zinc and butyl iodide and the content was stirred at reflux for five hours. Then, the solvent was removed and the excess zinc was completely dissolved. Successively, the solution was repeatedly washed with warm water until it became neutral. A part of the solution was extracted with benzene to separate BIS from BS. Finally, the BS was extracted with n-hexane to separate n-hexane solubles from n-hexane insolubles. The yield and ultimate analysis of each fraction were presented in percent to 100% of the original coal. These solvent-solubles seem to be mainly composed of highly alkylated compounds obtained without failure of basic skeletal structure though the reaction mechanism is not clarified. (3 figs, 2 tabs, 5 refs)

50460 (FSJ—8601, pp 273-276) **Application of steam-carrier gas chromatography for analysis of phenols and coal-derived oil.** Narita, Hideo; Maekawa, Yosuke. (Government industrial Development Lab., Hokkaido, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The basic characteristics of steam chromatography (SSC) using steam as the carrier gas and its applicability to the analysis of phenols contained in coal-derived oil were investigated by applying SSC to aqueous solution of phenols. The standard samples of phenols were prepared in such a way that 50 to 60 mg each of 24 reagent phenols accurately weighed out was dissolved in 1 ml of 100% NaOH aqueous solution which was diluted with 50 ml of distilled water. The result of the measurement of HETP indicates that at the column temperature of 160°C and the flow rate of carrier gas of 10 μl/min (in water equivalent) are appropriate for determining phenols at a constant temperature. By comparing the measurements of the content of acidic oil in coal-derived oil by SSC with those by the extraction method, it was found that the determination of phenols by SSC is feasible. (6 figs)

50461 (FSJ—8601, pp 277-278) **Analysis of coal derived pitches by PyGC/MS.** Kaihara, Mikio; Ichida, Syoji; Mametsuka, Hiroaki; Iwata, Hideo; Morotomi, Hidetoshi; Okada, Toshihiko; Matsubara, Kenji. (Nippon Kokan K. K., Technical Research Center, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Pyrolysis gas chromatography-mass spectrometry (Py GC/MS) was applied to the analysis of heavier hydrocarbon gas to establish the structural analysis technique of heavier hydrocarbons. Py GC/MS was made using a 50m-capillary column at the initial temperature of 100°C, the heating rate of 8°C/min and the final temperature of 300°C. The coal liquefaction was carried out using 80 mesh or under pulverized coal in a 15 times volume of creosote in the presence of the red mud-sulfur (6%) catalyst at 45°C for 30 minutes under the initial hydrogen pressure of 100 kg/cm². The residue was pulverized to 60 mesh or under and wrapped in a sheet of pyrofoil resistant to 1040°C. The residue was decomposed at 300°C for five seconds. Since the coal-derived residues obtained from four ranks of coal gave different programs, it was found that Py GC/MS is effective for the characterization of the coal-derived pitch. (4 figs)

50462 (FSJ—8601, pp 279-281) **Characterization of coal liquefaction residues.** Maruyama, Katsuhisa; Furuta, Takeshi; Yamaguchi, Kiyoshi; Shiraishi, Minoru; Imuta, Kazutoshi. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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In pursuit of efficient coal liquefaction techniques and effective utilization of coal residue, a study is made to determine the general characteristics and thermal decomposition behaviors of three liquefaction residue samples generated in different liquefaction processes. The samples, called S, K and N, respectively are residue from steam distillation of liquefied Wandoan coal, sedimentation of liquefied brown coal oil and vacuum distillation of liquefied Illinois coal oil. The samples are heated in a nitrogen atmosphere. The contents of thermal decomposition residue from the samples S, K and N heated at about 1,000°C is around 77 percent, 66 percent and 45 percent, respectively. Thermal decomposition starts at a rather low temperature in the samples K and N, while the sample S begins to decompose at a higher temperature. For low temperature ash of the samples S, K and N, the contents of residue are about 85 percent, 60 percent and 80 percent, respectively. The production rate of CO_2 from the sample K reaches a maximum at around 600°C. In the samples S and N, maximums in H_2 production rate are also found at around 400°C and 800°C. (4 figs, 4 tabs)

50463 (FSJ—8601, pp 290-292) **Studies of the catalysts for coal liquefaction (3). Comparison of catalytic hydrogenolysis of various catalysts on model compounds.** Sakurai, Atsushi; Oda, Hirokazu; Yokokawa, Chikao. (Kansai Univ., Faculty of Engineering, Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The hydrogenolysis of model compounds was investigated using ten catalysts and eleven model compounds, and the effect of tetralin on the reaction systems combined of three sulfide catalysts with six model compounds was also investigated. The model compounds hardly reacted in the non-catalytic reaction. The main reaction product from diphenyl was phenylcyclohexane and that from naphthalene was tetralin. The result of the reaction using tetralin containing a sulfide catalyst was compared with that in the reaction system containing tetralin. Although the rate of conversion of the non-catalytic reaction is generally increased by the addition of tetralin, the composition of reaction product is hardly changed. The addition of tetralin in the catalytic reaction affects the rate of conversion in some cases while it does not affect the rate of conversion in other cases. (3 tabs, 2 refs)

50464 (FSJ—8601, pp 298-301) **Studies on coal liquefaction (48). Catalysis of Fe compounds toward hydrogen transfer reactions.** Futamura, Shigeru; Higuchi, Hiroyuki; Fujimoto, Ken'ichiro; Kamiya, Yoshio. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The hydrocracking of trans-stilbene (t-s) with alpha-Fe and Fe/sub/1-x/S catalyst was investigated. The experiments were carried out under the following reaction conditions: (1) (t-s) of 3 gr, tetralin of 15 ml were used with Fe catalysts, (2) reaction temperature and time were 380 °C and 30 min, respectively. The Fe catalysts promoted the hydrogen transfer reactions from tetralin to (t-s), and 5 benzyltetralin , toluene were formed through 5-(1,2-diphenylethyl) tetralin, formation of bibenzyl and isomeric conversion of (t-s) occured as well. Pi-adsorption of (t-s) to the catalyst and cleavage of C-C bond also resulted in toluene formation. Sulfur contributed to easier hydrogen transfer as free radical. Fe catalysts promoted the hydrogen transfer reactions from hydrogen supplying solvent such as tetralin and gaseous phase hydrogen to the double bonds of (t-s). Alpha-Fe showed bigger hydrogen pressure dependence than that of Fe/sub/1-x/S. (4 figs, 1 tab, 1 ref)

50465 (FSJ—8601, pp 302-304) **Coal liquefaction activity of nickel catalyst by use of nickel acetate as a precursor.** Takemura, Yasuhiro; Okada, Kiyofumi. (Akita Univ., College of Education, Akita, Japan; Coal Mining Research Center, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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An experimental study is made to determine the performance of nickel catalyst for hydrogenating decomposition of several coal samples. Reaction is performed in a simple reaction system containing only hydrogen as reducing gas and using no catalysis promoters. Each reaction is performed in a batch-type autoclave. The reaction mixture is washed with benzene and subjected to suction filtration to remove insoluble benzene materials. Then the conversion rate of coal is measured. For each reaction, the relations of the conversion rate with the ratio (R) of tetralin/naphthalene in the reaction mixture are determined. Results show that the conversion rate tends to increase with the ratio R. For the liquefaction of Morwell coal, the use of a larger amount of the catalyst results in an increase in the conversion rate and amount of hydrogen transferred. The conversion rate gradually becomes higher with reaction time. coexistent stem has no effects. It is suggested that during liquefaction of coal with the nickel catalyst, hydrogen atoms directly activated by the nickel catalyst, instead of via tetralin, are contributing to the liquefaction of coal. (2 figs, 2 tabs, 3 refs)

50466 (FSJ—8601, pp 305-308) **Elucidation of liquefaction catalysis of $MoCl_3$-and $NiCl_2$-containing salts from structural analysis of coal-derived products by ^1H NMR.** Song, Chunshan; Nomura, Masakatsu. (Osaka Univ., Faculty of Engineering, Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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The ^1H NMR structural analysis was made on the coal liquids (HS) and the asphaltenes (BS) obtained from four types of coal. The coal liquefaction catalyses of MoCl and $NiCl_2$ molten salts were clucidated by using the differences in the hydrogen distribution of HS reacted with no catalysts and the catalysts, and in the obtained average structural parameters. In the case of the reaction with the catalysts, the amount of methylene radicals hydrogen increased selectively in the HS. This suggests that most of the hydrogenated aromatics were produced by hydrocracking the polycyclic aromatic heavy distillates, which was a result of the hydrocraking action of the catalysts. The (b)-methyl radical and (g)-rethylene radical hydrogene content of the HS reacted with the catalysts was low, and the C_1-C_4 gas yield was nearly the same as that of the HS reacted with the catalysts. These facts suggest that the cleavage and dealkylation of the hydrogenated aromatics produced was not progressed during the reaction. (6 tabs, 5 refs)

50467 (FSJ—8601, pp 309-312) **Coal liquefaction using oil soluble molybdenum catalyst (molybdenum dithiocarbamate) (1). Liquefaction of Taiheiyo coal.** Saito, Ikuo; Yamamoto, Yoshitaka; Sato, Yoshiki; Imuta, Kazutoshi. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

This study deals with high efficient liquefaction of coal. As catalysts for coal liquefaction, the oil-soluble Mo complex which contains a sulfur atom in the molecule, and can be converted to MoS under the liquefaction-reaction conditions, were used for coal liquefaction. The results were compared with those with other catalysts. In the reaction temperature range, the Mo complex was more active than a Red Mud plus sulfur catalyst. More particularly, for the molybdenum and the Red Mud catalyst, the conversion rate was 85%, 65% at 400°C, and the oil yield was 43%, 27% at 430°C, respectively. The difference in conversion is attributed mainly to the different SRC yields. The TLC-FID analysis of the SRC products has revealed that the SRC product obtained by using the Mo

catalyst was made lighter than that by using the Red Mud catalyst. The Mo catalyst was made lighter than that by using the Red Mud catalyst. The Mo catalyst given an oil at higher yield and a less gaseous product, as compared with the other Mo catalysts. It is supposed that the Mo complex was pyrolyzed at about 350°C and converted to that the Mo complex was pyrolyzed at about 350°C and converted to MoS_2, which served for the high conversion and yield. Further, it has been revealed that the Mo complex can be repeatedly used as the catalyst. (3 figs, 1 tab, 9 refs)

50468 (FSJ—8601, pp 313-316) **Hydrogenation of SRC-2 heavy distillate by sulfided molybdenum catalysts.** Saito, Atushi; Obara, Toshiyuki; Yamada, Muneyoshi; Amano, Akira; Yamamoto, Yoshitaka; Sato, Yoshiki. (Tohoku Univ., Faculty of Engineering, Sendai, Japan; National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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This paper describes the contact-hydrogenation of a SRC 11 heavy distillate using a $CoMo/Al_2O_3$ catalyst. Relationship between the hydrogenation of phenanthrene (Ph), and the hydrogenation-denitrification (HDN) and the hydrogenation-desulfurization (HDS) has been elucidated. As to the relationship between the initial hydrogenation activity of the catalyst sulfided and hydrogen-treated, and the HDN, HDS reactions, the amount of the dihydro compounds (H-Ph) decreased, and the amount of the octahydro compounds (H-Ph) rapidly increased with the reaction temperature elevated. For the HDS, HDN activities of the catalyst, the HDS reaction was progressed by about 70% at about 330°C in reaction temperature when Ph was scarcely hydrogenated. On the other hand, the HDN reaction was progressed with the hydrogenation of Ph. It has been made clear that the sulfided catalyst has a promoting effect on the hydrogenation of Ph to H_8Ph, and the HDN, HDFS activities. The promoting effect was especially remarkable for the HDS activity. Accordingly, for the HDS reaction, it is necessary to convert the catalyst to the sulfide. (4 figs, 1 tab, 4 refs)

50469 (FSJ—8601, pp 317-320) **Hydrocracking reaction of a SRC-2 heavy distillate over the molten metal catalysts.** Sugiura, Naoki; Ozawa, Sentaro; Ogino, Yoshisada. (Tohoku Univ., Faculty of Engineering, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Examination was made on the hydrocracking reaction of a SRC-2 heavy distillate by using molten metal catalysts. The hydrocracking was carried out at 7.9 MPa and 475°C in an autoclave. The catalysts inhibit gaseous and insoluble substances from being produced, and exert no influences on the hydrogen consumption. A SRC-2 heavy distillate containing fluorence, pyrene, and so on can be converted to a light oil. In the case of no catalyst and the Sn catalysts, the conversion is progressed. When the Bi, Zn catalysts are used, the convertion ratio is relatively low. Most of the total carbon content (Xt) of a liquid product is attributed to the aromatic carbon. The percentage of the aromatic carbon increases with Xt, as the hydrocracking time is prolonged. This is true of the side chains linked to the aromatic rings. The aromatic carbon content has a linear relationship to the Xt. The straight chain component is present in relatively large amount at the initial hydrocracking. The alkyl-multisubstited aromatics and their long side chain components are more hydrocracked with the progress of the reaction, and are converted to non-substituted or mono-substituted aromatics. The alkyl groups linked to the naphthene rings are not released. n-Paraffins scarcely produce gaseous substances at the initial hydrocracking reaction. (6 figs, 1 ref)

50470 (FSJ—8601, pp 312-324) **Low temparature depolymerization reaction of Yallourn brown coal by acidic catalyst.** Yokoyama, Yoshiyuki; Kato, Takashi; Ito, Hironori; Ouchi, Koji. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Examination was made on the low temperature depolymerization reaction of Yallourn brown coal (YBC) with acidic catalysts. Phenol (Ph) and p-toluene sulfonate were heated to be dehydrated. To the mixture, YBC was added, and was reacted at the boiling temperature of Ph for 10 hrs. The reaction product was extracted into pyridine (Py). The residue was repeatedly subjected to the reaction and the extraction with pyridine. The increase in weight of the reaction product was 25.4% by the first depolymerization reaction, and the accumulated increase by the first to the third depolymerization was 65.5%. This means a relatively large amount of Ph was addition-reacted with YBC. The IR spectra of the reaction products were taken for the analysis. The results suggest that the methylene linkages in the chemical structure of the coal were cleaved by the used acidic catalyst, so that Ph was addition-reacted. Also, the ester linkages in the coal polymeric structure of the coal were hydrolyzed, resulting in the increase of the caboxyl groups. The Py soluble reaction products and the methylated products of the Py soluble products were fractionated by GPC, and the molecular weight was determined. The results shows that, with the reaction procedure repeated, the depolymerization reaction was progressed, resulting in the decrease in the high polymeric fraction and the increased in the low molecular fraction, and the reduction in number average molecular weight. (3 figs, 2 tabs, 5 refs)

50471 (FSJ—8601, pp 325-328) **Studies on the foundational activities of hydrotreating catalyst. Studies on the support preparation and the amount of the metals.** Shimada, Hiromichi; Sato, Toshio; Yoshimura, Yuji; Nishijima, Akio; Kameoka, Takashi; Takakura, Kazuaki. (National Chemical Lab. for Industry, Ibaraki, Japan; Catalysts and Chemicals Industries Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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This study deals with Mo carrying catalysts for hydrotreating liquefied coal oil. Examination was made on relationship between the hydrogenation (HYG) and hydrocracking (HYC) activities of the catalysts, and the support preparation and metal amount. The HYG activities of the catalysts were evaluated by utilizing the hydrogenation of 1-methylnaphthalene, and the HYC activities utilizing the hydrocracking of diphenyl methane, in an autoclave. The different preparation (A, B, and C) of an alumina support led to the different catalytic activities. The alumina hydrate support A (by the preparation A), after aging, grew to be laminar. The support B grew to take a regular plate shape. The support C grew to take an irregular, laminar plate shape. The support A exhibited the largest change in the electron state of Al through the firing process. For the supports A, B, a higher concentration of the metal was found at the outer surface layer, as compared with the support C. For the Mo carrying state, the support C was different from the supports A, B. This led to the difference in the HYC of the catalysts. The HYG was enhaced with the Mo carrying amount increased, and then got into saturation at the certain concentration. The saturation area corresponds to the metal - atom layer. No increase in HYC was found till the Mo carried amount of 10%. At 15% or higher in the Mo carried amount of the catalysts, the HYC was quickly enhanced. (5 figs, 4 tabs, 2 refs)

50472 (FSJ—8601, pp 329-332) **Studies on deactivation of molybdenum catalysts used for hydrotreating coal-derived liquid.** Nishijima, Akio; Kubota, Masaaki; Sato, Toshio; Yoshimura, Yuji; Shimada, Hiromichi; Mito, Yutaka; Nakako, Yukio. (National Chemical Lab. for Industry, Ibaraki, Japan; Kobe Steel, Ltd., Chemical Industry Research Center, Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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After the long time treating tests of the prototype Mo catalysts designed for hydrotreatment of coal-derived liquid, the changes of properties and basic activities of the spent catalysts were examined and the deactivation behavior of catalysts were studied. The catalysts having relatively higher hydrotreating activities than hydrocracking activities were designed, and a catalyst A(1.6%NiO-6.7 %MoO_3/Al_2O_3) and a cayalyst B(1.6%NiO-6.7%MoO_3/TiO_2-Al_2O_3) were used for the study. Coal-derived liquid was derived from Morwell coal. Reaction conditions were as follows: H_2 pressure:14.8MPa, temperature :400°C,LHSV:0.5 and reaction time:1400h. Adhesion of metals on the catalysts, deposition of carbonaceous materials, and changes of dispersed and sulfurized states of active metal contents considered to have effect on deactivation of the catalysts were revealed. However, after this, the quantitative studies of the effects are necessary. (3 figs, 3 tabs, 1 ref)

50473 (FSJ—8601, pp 333-336) **Oxidative regeneration of Ni-Mo-gamma-Al_2O_3 catalysts used for hydrotreatment of coal-derived oil.** Yoshimura, Yuji; Furimsky, Edward; Sato, Toshio; Shimada, Hiromichi; Matsubayashi, Nobuyuki; Nishijima, Akio. (National Chemical Lab. for Industry, Ibaraki, Japan; Energy Research Labs., Canada Centre for Mineral and Energy Technology, Ottawa, Canada). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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In order to easily find the oxidative reaction characteristics of carbonaceous materials and sulfur deposited on the catalysts used for hydrogenation, oxidative regeneration behavior as studied with a fixed bed reactor, and the surfaces of the spent catalysts were analyzed by XPS to find the changes in form of active metals and sulfur on the catalysts. Ni-Mo-gamma-Al_2O_3 catalysts were used for hydrotreatment of primary coal-derived oil from Morwell coal. The spent catalysts were extracted by THF, dried and crushed into 100-200 mesh powder. The relation between catalyst regeneration temperature and CO_2 or SO_2, the relation between generated gas compositions and temperature in regeneration, and the activation energy of carbon and sulfur in the catalysts for oxidative reaction were indicated with data. As a result, it was found that a part of the active metals turned to sulfates by hydrotreatment and the residual sulfur existed in form of sulfate. (6 figs, 2 tabs, 4 refs)

50474 (FSJ—8601, pp 337-340) **Study on the secondary hydrogenation reaction conditions in BCL process.** Tachibana, Shigeo; Mito, Yutaka; Okuma, Osamu; Saito, Kaizaburo; Nakako, Yukio. (Kobe Steel Ltd., Chemical Industry Research Center, Tokyo, Japan; Nippon Brown Coal Liquefaction Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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As a part of the research optimizating BCL processes, the influences of secondary hydrogenation reaction conditions affecting the hydrogen donation of secondary hydrogenated oil were studied by use of 3.4 ring partial hydrogenated aromatics(PHA) contents for the index. Sample oil was prepared by dissolving the deashed oil derived from the primary hydrogenated Morwell coal into hydrogenated creosote oil. The experiments were performed by use of a secondary hydrogenation unit with a fixed bed reactor and Ni-Mo catalysts under the following conditions. Temperature:300-400°C, pressure:100-200kg/cm^{2}G, LHSV:0.5hr^{-1}, hydrogen/sample oil:1000/l, As a result, the ratio of PHA in the derived oil reached the maximum value at 360°C and 200kg/cm^2, while the ratio decreased according to increasing of pressure at 400°C. Since the degree of hydrogenation and the hydrogen donation indicated by fa values had no proportional relations, the optimal reaction condition was estimated to exist on the fa value of about 0.6. (5 figs, 2 tabs, 4 refs)

50475 (FSJ—8601, pp 341-344) **Design of cracking and refining reactions of coal liquid residue.** Mochida, Isao; Sakanishi, Kinya; Korai, Yozo; Fujitsu, Hiroshi. (Kyushu Univ., Research Inst. of Industrial Science, Fukuoka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since polar compounds especially preaphaltene and fractions including inorganic components(quinoline insoluble) have caused the deactivation of secondary hydrogenation catalysts for residue, the relations between the changes of compositions and structures of these materials before and after hydrogenation and the deactivation of the catalysts were examined. Also, the mechanisms of catalyst deactivation, the required functions for coking resistant and ash resistant catalysts, and the steps to prevent catalyst deactivation were studied. Coal liquid residue including a great amounts of ash for samples and presulfurized Ni-Mo/Al_2O_3 catalysts or trial Ni-Mo/TiO_2 catalysts were prepared, and a shaking autoclave were used for two-stage reactions. As a result, it was found that the control of pore structures of carriers for the ash resistant catalysts and the control of acid strength of carriers for the coking resistant catalysts were important, and ash resistant high hydrogenerating catalysts in the first stage and coking resistant high cracking catalysts in the second stage were desired. (1 fig, 2tabs, 10 refs)

50476 (FSJ—8601, pp 345-348) **Effect of CS_2 addition on the hydrotreatment of middle and heavy distillate of coal liquid.** Sato, Yoshiki; Yamamoto, Yoshitaka; Miki, Keiji; Saito, Ikuo; Shiraishi, Minoru. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Adding required amounts of CS_2 to the hydrotreatment reaction system of middle and heavy distillate of coal liquid, the relations between the characteristics and compositions of sample oils and the hydrotreating and denitrificating reactivities or the characteristics of spent catalysts were studied, Middle and heavy distillates derived from Wandoan coal were prepared for the sample oils, and Ni-Mo/Al_2O_3 catalysts and a small high pressure flow type unit were used, The added amounts of CS_2 were 1,5 or 10 wt%, As CS_2 of 1 wt% was added to the middle distillate, tetralin/naphthalene ratio(T/N ratio) in hydrotreated oil dramatically increased, whereas the heavy distillate T/N ratio decreased, Why the heavy distillate had more inferior hydrotreating or denitrificating reactivities by the addition of CS_2 than that of the middle distillate was estimated to bedue to a great amounts of aromatic nitrogen compounds in the sample oils. (2 figs, 4 tabs, 2 refs)

50477 (FSJ—8601, pp 353-355) **Characterization of the extracts with carbon disulfide-n-methyl-2-pyrrolidone mixture.** Iino, Masashi; Obara, Satoshi. (Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since CS_2-n-methyl-2-pyrrolidone(CS_2-MP) mixture had high degree of extraction for bituminous coal at room temperature, the characteristics of fractions separated from the extracts using pyridine and aceton solvents were studied. Zao-Zhuang coal, Shin-Yubari coal, Miike coal and Lower Kittanning coal were crushed to obtain the sample powders of 60 mesh or less, and aceton soluble(AS), pyridine soluble(PS) and pyridine insoluble(MS) were fractionated. As a result, the obtained amounts of MS was proportional to the degree of CS_2-MP extraction of each sample, the rank

of H/C ratio were AS>PS>MSuresidue, and the rank of (S+O)% were AS<PS<MS<residue. Comparisons of the amounts of volatile components on anhydrous and ashless base indicated that in Shin-Yubari coal, the residue contained more amounts than the extracts and the other coals had inverse relations. The structure parameters of each fraction will be studied in near future. (3 figs, 3 tabs, 2 refs)

50478 (FSJ—8601, pp 356-358) **Upgrading of the coal extracts from the extraction with carbon disulfide-n-methyl-2-pyrrolidone mixture.** Yong, Xian; Iino, Masashi. (Tohoku Univ., Chemical Research Inst. of Non-Aqueous Solutions, Sendai, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

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Since CS_2-n-methyl-2-pyrrolidone(CS_2-MP) mixture had high degree of extraction for bituminous coal at room temperature, the extracts by the mixture and the fractions separated by solvents were pyrolytically decomposed with teralin solvent, and coking reactions and others were studied, Sample coals were prepared from Zao-Zhuang coal(A) and Shin-Yubari coal(B), and CS_2-MP soluble, THF insoluble, preasphaltene and asphaltene were prepared for thermolysis, Raw coal were pyrolytically decomposed with the tetralin solvent using a autoclave, As a result, The degree of the mixture extraction at room temperature and the degree of the extraction after thermolysis were 64.5, 83.3wt% in (A) and 60.3, 100.0wt% in (B), respectively. The thermolysis was easy to derive heavy oil at 450°C, and oil yield was high at 400°C, (2 figs, 4 tabs, 1 ref)

50479 (FSJ—8601, pp 359-361) **Oxidation reaction of basic fractions involved in coal-derived liquids by ruthenium catalyst.** Hara, Takao; Takeda, Yasusuke; Matsumura, Tomoyuki. (Yokohama National Univ., Faculty of Engineering, Yokohama, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Coal derived heavy oils such as coal-derived liquid basic fractions or coal tar basic oils were oxidized by hypochlorous acid ion using ruthenium catalysts, and the synthesis of useful chemical substances such as quinolinic acid or cinchomeronic acid were studied. Oxidative reaction of the basic fractions or various model compounds were carried out to agitate violently the solutions composing of required substrates, Ru(III), sodium hydroxide and sodium hypochlorite. Quinolinic acid was quantified individually by copper quinolinide, while HPLC method for rapid quantitative analysis was used commonly. Indicating the detailed experimental data of process deriving quinolinic acid by oxidizing of quinoline, it was pointed out to exist a fair agreement between the normal behavior of the basic fractions and that of quinoline. Also, quinolinic acid of 12.3% (HPLC yield) and cinchomeronic acid of 14.4% were derived from the coal tar basic oil. (3 figs, 3 tabs)

50480 (FSJ—8601, pp 362-365) **Catalysis of metal-clay intercalation compound in the low temperature coal hydrogasification.** Fuda, Kiyoshi; Kimura, Mitsuhiko; Miyamoto, Norimitsu; Matsunaga, Toshiaki. (Akita Univ., Mining College, Akita, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Focusing the hydrogenating methanation by gaseous phase catalytic reactions of low temperature volatile components, the catalytic effects of Ni metal and the effects of carriers having sensitive effects on the catalytic activities of Ni metal were studied. Sample coals were prepared from Shin-Yubari coal, and Ni hydride-montmorillonite complex catalysts and the catalysts produced by carring Ni nitrate on alumina and burning in hydrogen gas flows were prepared. The hydrogasification were carried out in a reaction tube. As a result, the montmorillonite-Ni compounds catalysts had high catalitic effects and high conversion ratio of 90% or more in the low temperature coal gasification. The catalitic effects of carried Ni metal strongly depended on the carrier substances, and the rank of effects for the carriers was montmorillonite>zeorite>TiO_2>alpha-Al_2O_3>MgO>SiO_2=gamma-Al_2O_3. (3 figs, 3 tabs, 3 refs)

50481 (FSJ—8601, pp 294-297) **Studies of coal liquefaction (50). Catalysis of iron compounds.** Tamura, Tomoyuki; Ogata, Eisuke; Kamiya, Yoshio. (The Univ.of Tokyo, Faculty of Engineering, Tokyo, Japan). 23 Oct 1956. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

A study is made to determine the catalytic actions and changes in grain size and surface area of various iron compound catalysts used for hydrogenation of phenanthrene. Effects of oxygen-containing compounds on the reaction are also investigated. Reactions of phenanthrene or CLB samples are performed in decalin or 1-methylnaphthalene as solvent. The solid reaction residue, including the catalyst used, is filtered and washed in acetone to provide specimens for SEM, surface area measurement (BET) and XRD. Three of the iron catalysts examined, CGS, $FE(CO)_5$ and FeS_2, are found to be highly effective for both phenanthrene hydrogenation and CLB decomposition, while Fe_3C does not work effectively for either of them. Fe (zero valene) and Fe_2O_3 are found effective for phenanthrene hydrogenation but not for CLB decomposition. (7 tabs)

50482 (IEACR—08) **Catalysis in coal liquefaction: New directions for research.** Derbyshire, F.J. (IEA Coal Research, London (UK)). Jun 1988. 70p. NTIS (US Sales Only), PC A04. Order Number TI88016860/JAW.

The economic viability and operability of processes to convert coals to useful liquid products could be greatly improved by the successful development and application of suitable catalysts. New and improved catalysts can lead to more favorable process economics by increasing the rates of reaction and product selectively and by lowering reaction temperatures and pressures. Hydrogenation catalysts, such as certain metal sulfides, may function by providing a source of H atoms through the dissociation of molecular hydrogen. The H atoms can promote bond cleavage reactions and assist in stabilizing the products of these reactions. The partial pressure of H_2S is important to the catalyst mechanism. Acid catalysts, such as metal halides, promote bond cleavage by an ionic mechanism. In general, they are not particularly active hydrogenation catalysts which create the potential for the stabilization of cracked products through the formation of high molecular weight adducts. Consideration has been given to the limitations of these catalysts and to approaches which could lead to improvements in their performance and utilization. Multicomponent systems appear to offer excellent prospects for the development of more active and selective catalysts. Existing supported catalysts are quite adequate to the task of hydroprocessing distillate coal liquids. In the presence of high boiling and nondistillable coal-derived liquids they are rapidly deactivated by the deposition of carbonaceous materials and metals. One prospective solution to this problem is to generate feeds which are more amenable to upgrading by enhanced catalytic control of the dissolution process. There is also a need for the development of supported catalysts which are resistant to deactivation. 275 refs.

50483 (KFK—4412) **Technology assessment of various coal fuel-options.** Coenen, R.; Findling, B.; Klein-Vielhauer, S.; Nieke, E.; Paschen, H.; Tangen, H.; Wintzer, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse). Apr 1988. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754304/JAW.

The technology assessment study of coal-based fuels presented was performed for the Federal Ministry for Research and Technology. Its goal was to support decision-making in the field of coal conversion. Various technical options of coal liquefaction have been analyzed on the basis of hard coal as well as lignite - direct liquefaction of coal (hydrogenation) and different possibilities of indirect liquefaction, that is the production of fuels (methanol, gasoline) by processing products of coal gasification. The TA study takes into consideration the entire technology chain from coal

mining via coal conversion to the utilization of coal-based fuels in road transport. The analysis focuses on costs of the various options, overall economic effects, which include effects on employment and public budgets, and on environmental consequences compared to the use of liquid fuels derived from oil. Furthermore, requirements of infrastructure and other problems of the introduction of coal-based fuels as well as prospects for the export of technologies of direct and indirect coal liquefaction have been analyzed in the study.

50484 **(KFK—4412e) Technology assessment of various coal fuel-options.** Coenen, R.; Findling, B.; Klein-Vielhauer, S.; Nieke, E.; Paschen, H.; Tangen, H.; Wintzer, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse). Apr 1988. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754582/JAW.

The technology assessment study of coal-based fuels presented in this report was performed for the Federal Ministry for Research and Technology. Its goal was to support decision-making of the Federal Ministry for Research and Technology in the field of coal conversion. Various technical options of coal liquefaction have been analyzed on the basis of hard coal as well as lignite - direct liquefaction of coal (hydrogenation) and different possibilities of indirect liquefaction, that is the production of fuels (methanol, gasoline) by processing products of coal gasification. The TA study takes into consideration the entire technology chain from coal mining via coal conversion to the utilization of coal-based fuels in road transport. The analysis focuses on costs of the various options, overall economic effects, which include effects on employment and public budgets, and on environmental consequences compared to the use of liquid fuels derived from oil. Furthermore, requirements of infrastructure and other problems of the introduction of coal-based fuels as well as prospects for the export of technologies of direct and indirect coal liquefaction have been analyzed in the study.

50485 (MMIJ—8801, pp 165-166) **Temperature in the fluidized bed at steam-air coal gasification.** Kojima, Akinori; Tanaka, Koichi; Komiyama, Tomoko. (Seikei Univ., Faculty of Engineering, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

As a coal gasification unit, a fluidized bed and ajet stream layer types are regarded as promising ones. In a fluidized gasification furnace, a clinker trouble is caused if the coal efficiency is made too high by elevating the furnace temperature. In an ash agglomerating furnace, carbon utilization can be improved by recycling the formed fine ash to return to the furnace while the agglomerated ash (almost without any unburned carbon) is extracted from the bottom. This type of furnace has been developed in USA, but almost none in Japan. In this study, a compact batch type fluidized bed gasification furnace was used to measure the temperature distribution in the layer and its time-wise change by injecting air through the nozzle at the time of gasification. The experiment showed a jet-like distribution of the temperature in the layer. (6 figs, 4 tabs)

50486 (MMIJ—8801, pp 431-432) **Basic study on low-ash coal production.** Hirashima, Tsuyoshi; Takamori, Takakatsu; Miyashita, Mamoru; Ou, Kusunoki; Tsunekawa, Masami. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

To obtain data for producing low-ash coal, the following study was conducted on coals in various specific gravity ranges: (1) maceral group analysis, (2) particle size distribution measurement and X-ray diffraction after reduction to ash at low temperature, and (3) ash elimination tests. The results are as follows: (1) The maceral density level (gray level) of each specimen was measured to classify specimens into vitrinite and inertinite groups; the ratio between these groups was calculated. (2) The specimen was ground to fine particles, reduced to ash, and subjected to X-ray diffraction. For specimens with some specific gravity range, peaks caused by kaolins and quartz were found. Particle size distribution and weight frequency distribution were measured using natural and centrifugal settling. Since the mineral particle size of the specimens used in the experiment is relatively large, it is likely that low-ash coal can be obtained by grinding. (3) The specimen was ground under wet condition and dried; they were then subjected to particle size distribution measurement, float-and-sink analysis, and granulation in water; the ash and yield rate were obtained for each grinding period. (6 figs, 1 tab)

50487 (MMIJ—8801, pp 433-434) **Study on chemical desulfurization and ash elimination of coal using microwave irradiation.** Ogawa, Katsumi; Hasuda, Tetsuhiko; Kamegaya, Hiroshi; Saito, Takehiro. (National Research Inst. for Pollution and Resources, Tsukuba, Japan; Shibaura Inst. of Tech., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Microwave irradiation for desulfurization and ash elimination before coal combustion was studied. Three types of coal from Japan and other countries were used as specimens. An aqueous alkali solution was added to the specimen which was ground; microwave was irradiated on the mixture; sulfur compounds and residual alkali were washed away using water and diluted hydrochloric acid; the specimen was then dried and analyzed. The results of analysis are as follows: (1) For Miike coal, the degree of desulfurization is higher when the alkali concentration is higher; however, irradiation time variations within one minute are insignificant. When the irradiation time was 1.5 to 2 minutes, the specimen was desulfurized considerably, but the ash content increased. (2) For Taiheiyo coal, the effect of desulfurization was not appreciable, but the ash content was lower when the irradiation time was longer. (3) For Indiana coal, two-minute irradiation raised the ash content. (4) When a cycle of irradiation and washing was repeated, the sulfur content became constant when the number of cycles reached 4, but ash remained to be eliminated. (5) Too much irradiation of microwave increased the ash content. (6 figs)

50488 **(PB—88-232772/XAB) Laboratory study of small-scale lateral-growth mechanisms for underground coal gasification. Final report, January 1984-January 1988.** Riggs, J.B. (Texas Tech Univ., Lubbock (USA). Dept. of Chemical Engineering). Feb 1988. 36p. NTIS, PC A03/MF A01.

Quarried coal blocks housed in a refractory chamber were exposed to high-temperature gases approximating underground coal gasification (UCG) conditions. The exposed coal faces were monitored to determine the small-scale mechanisms of lateral cavity growth. Side-wall tests indicate that the lateral growth process is heat transfer-controlled gasification. In roof tests, significant spalling rates were observed for the lignite samples while Hanna coal showed no spalling.

50489 **(RI—9169) Coal particle pyrolysis mechanisms and temperatures.** Hertzberg, M.; Zlockower, I.A.; Edwards, J.C. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 39p. Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

This Bureau of Mines report analyzes diverse observations of the rates and mechanisms for the pyrolysis and devolatilization of coal and polymethylmethacrylate (PMMA). New data are presented for PMMA, together with new morphological evidence for the microscopic structure of the pyrolysis and devolatilization wave front in coals. It is concluded that there is no substantive evidence to support the traditional viewpoint that the pyrolysis and devolatilization rate process occurs isothermally, under chemical rate control; or is described realistically by a classical, unimolecular Arrhenius function of temperature. Instead, the reaction process occurs as a highly nonisothermal, heat-flux-driven, pyrolysis and devolatilization wave front, whose speed of propagation is predictable by internal heat transport constraints. Except for the complication of its char-layer residue, whose increasing thickness insulates the pyrolysis wave front from the heat source flux that drives it, both coal and PMMA behave similiary during pyrolysis and devolatilization.

For PMMA, decomposition occurs at a temperature of 350° to 550°C; for coal it occurs at 450° to 600°C. There is no evidence that the reactant temperature ever exceeds those values regardless of the source temperature to which the samples are exposed.

50490 (UCRL—53615-86, pp 19-22) **Fossil energy.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Fossil Energy Group supports several energy projects in the Earth Sciences Department. These projects range from research in oil shale retorting to studies of the granular flow of solids and production of gas from unconventional gas reservoirs. Two programs are particularly noteworthy in 1986: the granular flow of solid material and petroleum geochemistry. Accomplishments in both of these programs are described. Recent publications are listed. 24 references.

50491 **Hydrodesulfurization model complexes: nucleophilic addition to π-coordinated benzo[b]thiophenes and thiophene.** Huckett, S.C.; Angelici, R.J. (Iowa State Univ., Ames (USA)). *Organometallics;* 7: No. 7, 1491-1500(Jul 1988). Contract W-7405-ENG-82.

The π-bound thiophene (T) and benzo[b]thiophene (BT) complexes $[CpRu(BT)]^+$, $[Cp^*Ir(BT)]^{2+}$, and $[Cp^*Ir(T)^{2+}$, models for the adsorption of thiophenic compounds to hydrodesulfurization (HDS) catalysts surfaces, react with a variety of nucleophiles (H^-, MeO^-, $(MeO_2C)_2CH^-$, EtS^-, and phosphines). The BT complexes yield the first isolable transition-metal cyclohexadienyl complexes derived from fused ring aromatic ligands; four isomers of each cyclohexadienyl complex are produced. The isomers results from addition at the four carbons on the benzene ring; for the nucleophiles studied, addition occurs preferentially at the carbon closest to the sulfur atom, C7. This isomer of CpRu(BT x H) has been characterized by an X-ray structure determination. The T complex reacts with phosphines to produce $[Cp^*Ir(eta^4\text{-}T \times PR_3)]^{2+}$. Double nucleophilic addition reactions (H^- and MeO^-) of $[Cp^*Ir(BT)]^{2+}$ are also discussed. Reaction of either $NaBet_3H$ or Cp_2CO with $[Cp^*Ir(T)]^{2+}$ results in a 2e reduction of the Ir complex. On the basis of ^1H NMR data and by analogy to related complexes, this product is formulated as $Cp^*Ir(eta^4\text{-}T)$.

0105 By-products

REFER ALSO TO CITATION(S) 50372, 50426, 50427, 50428, 50429, 50432, 50433

50492 (FSJ—8601, pp 83-85) **Studies of carbons derived from coal for cultivation of microorganism (1).** Hara, Yoichiro; Tatsumoto, Katsunobu; Ida, Shiro; Ogawa, Makoto. (Mitsui Mining Co., Ltd., Kitakyushu Cokong Works, Fukuoka, Japan; Forestry and Forest Products Research Inst., Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Coal-derived carbonaceous materials for cultivating microorganisms in the soil were developed. A plant culture test was made using two of them and two kinds of commercially available charcoal. The specific surface area and bulk density of Carbons A and B are 192 and 222 m^2/g, and 0.11 and 0.69 g/ml, respectively. Although plant growth is stimulated by inoculating sterilized soil with mycorrhiza bacteria, plant growth is accelerated by adding the carbonaceous material. Carbon A showed the highest effect among them. The effect for cucumber and apple was the same as for tomato. Since it was found that the effect of acceleration of growth depends upon the kinds of carbonous material, it was investigated from the structure of pore. The pore diameter of carbonaceous material requires 10 μm or more because the size of cell of spawn such as mycorrhize is 8 to 12 μm wide. Carbon A satisfies the requirements. It is considered, therefore, that macro-void of carbonaceous material is suited for the place where soil microorganisms live. (2 figs, 1 tab, 1 ref)

50493 (FSJ—8601, pp 86-89) **Oxidation of fine particles prepared from atomized coal tar pitch.** Torikai, Naochika; Meguro, Takeshi; Saito, Yoshiharu; Wakasa, Tsutomu. (Yokohama National Univ., Faculty of Engineering, Yokohama, Japan; Nippon Electrode Co., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Fine particles of coal-tar pitch prepared by heat-spraying was oxidized by air to infusibilize them. The reaction mechanism was estimated and the effect of the infusibilization on the structure was investigated. The ratio of C/H linearly increases as the infusibilizing temperature is raised and the polycondensation of pitch proceeds as the infusibilization progresses. This is probably because the polycondensation is accerelated by the uptake of hydrogen by oxygen. The sample was carbonized at 430°C for three hours to observe the infusibilization. The result indicates that only the sample infusibilized at 250°C does not melt and weld. Anhydrides, lactone and ether-bond in the sample infusibilized at 250°C or higher are identified by the FT-IR spectrum. It is considered, therefore, that the degree of infusibilization closely relates these oxygen containing functional groups. (3 figs, 1 tab)

50494 (FSJ—8601, pp 220-223) **Development of simulation model for distillation column and its application to reconstruction and operation of tar distillation column.** Matoba, Yoshiyuki; Kashiwara, Yoshiyuki. (Sumitomo Metal Industries Ltd., Instrument and Control Technology Center, Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

A simulation model was developed for obtaining the profile in distillation column and the composition of product from the conditions of equipment and operation aiming at the optimization of design and operation of distillation column. An equation of state was derived from the mass balance, enthalpy balance and gas-liquid equilibrium and the convert Newton-Raphson model was applied to numerically solve the equation. The model was applied to the design for reconstructing the distillation column and optimizing the operation. As a result, the yield of naphthalene was remarkably improved as. The plate efficiency calculated from the model agreed with that of the actual value. It was confirmed, therefore, that the model is accurate. The recovery rate was actually able to be improved by reconstructing the column using the model as expected. The result of the study for optimizing the operational conditions indicates that there is an appropriate reflux ratio for the recovery rate of naphthalene with the limitation (7% or less) of tar acid at the top of column. (7 figs, 1 tab, 4 refs)

50495 (FSJ—8601, pp 349-352) **Study on effective separation of quinoline insolubles from coal tar.** Iwahashi, Toru; Sunami, Yoshihiko. (Sumitomo Metal Industries Ltd., Technical Research Lab., Osaka, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

On the separation of quinoline insolubles(QI) by use of solvent extraction, it was found that ketones solvents were superior in coarse graining or the separation of QI. Sample oil removed the lighter oil than naphthalene oil from the coal tar derived by high temperature carbonization of coal were prepared, and the commercial solvents having boiling points of 100°C or less and specific gravities of 1,00 or less were selected. Testing aliphatic, alcohol, aromatic and ketones solvents, the following results were obtained. QI in the tar could be changed to the coarse grain insolubles of 70 micron or more by the ketones solvents, the insolubles could be separated very easily from the tar, and a centrifugation efficiency (centrifugal effect x separating time) of the ketones insolubles washigh as about 1/10 compared to that of the benzene insolubles. Furthermore, it was estimated that QI was absorbed to form the coarse grains by the binding function of HI-BS fractions in the tar. (4 figs, 3 tabs)

50496 (MMIJ—8801, pp 467-468) **Direct reduction of zinc sulfide concentrates using coal and calcium carbonate.** Zan, F.F.; Asakura, Iwazo; Ogawa, Osamu. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan; Zonnan Inst. of Tech., , China). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

As already reported, zinc sulfide can be reduced efficiently using calcium oxide (CaO). This time, the strength and reducibility of carbonized briquettes were studied using calcium carbonate $CaCO_3$. The specimen formulation was as follows: $ZnS:C:CaCO_3$ = 1:3.0:1.2. The specimen was heated, then compressed to form. Carbonization should be performed at low temperature for a short period; however, 700°C and 300 minutes are best considering the collection of zinc vapor at the subsequent process. $CaCO_3$ is better than CaO in the speed at which the zinc sulfide in the carbonized briquette is reduced. The reduction rate was 99% or more, and the percentage of fixed sulfur was substantially 100%. In addition, the residual briquette kept strong considerably. This means that the feasibility of replacing CaO which is expensive and is difficult to handle has been proved in laboratory environment. It is expected that this carbonized briquette can be used as material for vertical and electric distillation columns. (3 figs, 1 tab, 3 refs)

0106 Properties

REFER ALSO TO CITATION(S) 50354, 50419, 50430, 50431, 50446, 50457, 50458, 50477, 50534, 50539, 50591, 51732

50497 (CONF-860548—, pp 37-51) **Modelling the rheological behavior of high solids CWM systems using a new rheological equation.** Hafaiedh, A.; Dinger, D.R.; Funk, J.E. (Alfred Univ., NY (USA)). 1986. NTIS, PC A 99. Order Number DE88012263/JAW.

From 8. international symposium on coal slurry fuels preparation and utilization; Orlando, FL, USA (27 May 1986).

The understanding of the rheology of concentrated suspensions is an important part of the control and preparation of ceramic slips and pastes and coal water slurries. Many studies have been conducted on concentrated suspensions; many attempts have been made to formulate equations which describe their behavior; and many attempts have been made to use these equations to predict the behavior of slurries and slips. This paper describes a modification to one of the more commonly used rheological equations, the Bingham equation, and the initial attempts to use it to understand and model the rheological behavior of high solids CWM. The paper includes the description of the new equation, its derivation, and examples of the various forms of the resulting rheograms. Then in the second part of the paper, the equation is used to analyze the behavior of some typical CWM systems made from Cedar Grove and Moss seam coals. 8 references, 16 figures.

50498 (CONF-860548—, pp 63-76) **Evaluation of CWM dispersants correlating zeta potential, pH, and rheology.** McLaughlin, M.A.; Funk, J.E.; Dinger, D.R. (Alfred Univ., NY (USA)). 1986. NTIS, PC A 99. Order Number DE88012263/JAW.

From 8. international symposium on coal slurry fuels preparation and utilization; Orlando, FL, USA (27 May 1986).

This is a progress report on research to correlate the measure of Zeta Potential at different concentrations of dispersants and ph with the rheological properties of crowded slurries of coal and ceramic systems. The ceramic powders provide better understood surfaces than coal for evaluation of dispersant effectiveness, and may elucidate the contribution of the ash mineral matter to whole coal CWM's rheology. 11 references, 18 figures.

50499 **(CONF-8808104—1) Microbial coal solubilization in defined culture systems: Biochemical and physiological studies.** Faison, B.D.; Lewis, S.N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015549/JAW.

From DOE Office of Fossil Energy workshop on processing of coals; Tyson's Corner, VA, USA (15 Aug 1988).

Paecilomyces TLi, a fungus isolated from coal, had previously been shown to transform solid coal into a water-miscible liquid during surface growth on coal or on a complex, solid microbiological medium. Coal solubilization has now been demonstrated in submerged cultures grown in defined liquid minimal media, although activity under these conditions is less than that observed in surface culture. Coal solubilization occurs under both alkaline and acidic conditions. Alkaline catalysis by biogenic materials(s), produced in specific response to the presence of coal, has been implicated in both systems. A variety of oxidized hydrocarbon substrates, including both aliphatic and aromatic compounds, can be utilized by this organism. Coal solubilization is enhanced by growth on aromatic compounds structurally related to lignin or coal monomers. Preliminary evidence suggests that coal solubilizing activity is self-regulating in this organism. 8 refs., 2 figs., 6 tabs.

50500 (DOE/METC—87/6082, pp 313-326) **Assessment of instrumentation needs for advanced coal conversion power plants.** Nelson, E.T. (Gilbert/Commonwealth, Inc., Reading, PA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23088.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The purpose of this study is to provide an assessment of instrumentation needs for advanced coal conversion process applications. Integrated Gasification Combined Cycle (IGCC), Pressurized Fluidized Bed Combustion (PFBC), and Molten Carbonate Fuel Cell (MCFC) power systems are considered. The study involves identifying contaminants and their control levels in power system gas streams, assessing available instrumentation for measuring and monitoring these contaminants, and identifying deficiencies in the types of instruments available. Results and accomplishments to date include a review of published designs for IGCC, PFBC, MCFC power systems, the identification of their gas stream contaminants, and the development of appropriate gas stream contaminant control strategies. A preliminary instrumentation requirements and availabilities assessment methodology has been developed and used to list instrument requirements and availabilities. These results are discussed. 6 references, 4 tables.

50501 (EPRI-CS—5713, pp 4.1-4.10) **Carolina Power and Light purchasing model (COALBUY).** Corson, P.B. (Carolina Power & Light, Raleigh, NC (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

Carolina Power and Light Company (CP & L) purchases coal for all of its coal-fired units through CP & L's Fossil Fuel Section of its Fuel Department. The Fossil Fuel Performance Unit of the Fossil Operations Department monitors plant experience with the purchased coal and provides feedback to the Fuel Department on specific coal quality requirements for the various plants. CP & L uses a computer program called EVAL to maintain files on quotations and purchase orders, to select suppliers of spot-market coal, and to plan the distribution of long-term and spot-market purchases throughout the generating system each month. Within the EVAL program is a set of subroutines called COALBUY, which calculates the operating expense incurred by utilizing coal of a given quality at a selected generating unit. The COALBUY program is the subject of this paper. Program outputs include: (1) a series of operating penalties and the total evaluated cost of the coal in $/MBtu; (2) load limitation on generating unit capacity, if any, and identification of the equipment causing the load limitation; (3) operating characteristics of boiler fans with reference coal and with purchased coal; and (4) boiler efficiency losses and related parameters. These outputs are briefly described. Modifications and enhancements to the program are discussed.

50502 (EPRI-CS—5713, pp 5.1-5.15) **Coal quality engineering analysis used to evaluate coal purchases.** Mancini, R.A.; Hopkins, B.W.; Hodde, J.A. (New York State Electric & Gas, Binghamton (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

Faced with the decision to buy lower quality coal from local mines at a relatively low cost or going farther away to buy higher quality and higher cost coals, New York State Electric and Gas Company developed a tool to evaluate the cost impacts of coal quality on its power plants. This paper describes the tool, called Coal Quality Engineering Analysis, being used in coal procurement and generating station operations. In its application at NYSEG, the CQEA system has led to the following conclusions. (1) Coal quality-related costs are not as large as delivered fuel costs. However, they are too large to ignore in coal procurement decisions. (2) Coal quality-related costs can change the decision of which coal to buy. (3) Without the use of an engineering model like the CQEA, it is not possible to quantify the impact of coal quality on unit operating costs, either from unit-to-unit or from one coal to another. The CQEA provides utility coal buyers and planners with an important new tool to use in evaluating coal supplies.

50503 (EPRI-CS—5713, pp A.1-A.20) **Application of EPRI's coal quality impact model.** Boushka, M. (Black & Veatch Architects and Engineers, Overland Park, KS (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

EPRI's coal quality impact model (CQIM) is described in a series of slides. Data input, data manipulation capabilities, flexibility, and its modular organization are summarized. Program output which is available and status of development are also briefly described. For each coal evaluated, CQIM carries out the following calculations: combustion calculations; coal rank and required fineness; coal slagging, fouling, and erosion potentials; air quality control emission limits; boiler efficiency; simplified steam generator heat transfer analysis; and equipment performance, system capability, and system availability/maintenance costs for all equipment impacted by coal quality.

50504 (EPRI-CS—5982) **Evaluation of pozzolanic applications for leached fly ash: Final report.** Hemmings, R.T.; Berry, E.E.; Cornelius, B.J. (Electric Power Research Inst., Palo Alto, CA (USA); Ontario Research Foundation, Sheridan Park (Canada)). Aug 1988. 74p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303.. Order Number TI88016696/JAW.

Direct acid leaching (DAL) with HCl to recover Al and other metal values from fly ash has been examined extensively by EPRI under RP2422. Large scale utilization of the solid residues from the DAL- process (DAL-residues) could significantly influence the economics of resource recovery. This report presents a detailed investigation of the potential use of DAL-residues as pozzolan in the concrete industry. A review was made of the literature on acid activation of fly ash. Samples of six ashes from a range of coal types were beneficiated to remove magnetic particles and particles larger than 45 μm. The beneficiated fractions were leached with 6M HCl at 105{degree}C to determine metals recovery for Al, Fe, Ca, Mg, Na, K, and Ti. The corresponding DAL-residues were characterized by chemical composition, morphology and mineralogical content, and examined as potential concrete pozzolans by standard ASTM tests. One DAL-residue from a high-rank coal was examined more extensively in Portland cement mortars and concretes. Results are discussed. 81 refs., 9 figs., 14 tabs.

50505 (FSJ—8601, pp 261-264) **Analysis of neutral-polar oil obtained by the mild stepwise hydrogenation of Wandoan coal.** Dong, Ji-Zhou; Kato, Takashi; Ito, Hironori; Ouchi, Koji. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Wandoan coal was stepwise hydrogenated at 320 to 380°C and the neutral polar oil in the product (12.6%) hydrogenated in the first step was analyzed to examine the origin of polycyclic aromatic compounds in the hydrogenated oil. The experimental result indicates that the neutral polar distillates contain three systems of alkyl phenols, polycyclic aromatic compounds as well as straight chain fatty esters. It was confirmed that alkylcyclohexane or alkylbenzene mainly contained in coal liquids is derived from dehydroxyl of alkylphenol and saturation reaction. Since the nucleus of aromatic compound contained in the neutral polar distillates is similar to that contained in the bottom, the structure of coal can be estimated. (4 figs, 1 tab, 4 refs)

50506 (FSJ—8601, pp 160-162) **Study on coal swelling in heated solvent (1). Development of direct measuring method for coal swelling by soft X-ray.** Sakamoto, Tsuyoshi; Nakada, Masao; Arita, Seiji. (Government Industrial Research Inst., Kyushu, Saga, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

A direct measuring method for coal swelling by soft X-ray was studied. Coal particles and a solvent were set in an aluminum cell, and an interface of the coal layer and the solvent was detected by absorption spectrum of soft X-ray. Thus the rising interface of coal layer due to thermal swelling by heating was measured directly. There are three kinds of conventional measuring methods for coal swelling in heated solvent: gravimetric method, volumetric method, and microscopic observation. In this experiment, the results obtained from the direct measuring method by soft X-ray were compared with that of from other measuring methods. Swelling Wandoan coal by pyridine at 50°C, the swelling ratio was calculated from the comparison of before-swelling height of the coal interface with after-swelling height of it. The results were almost equal to the ones obtained from other methods in which the coal; nearly equal to the coal rank(C:79.80%) of Wandoan; was swelled by pyridine at room temperature. this method, with simple handling, was found to be available as a direct measuring method for coal swelling at high temperature. (4 figs, 1 tab)

50507 (FSJ—8601, pp 163-166) **Studies on coal swelling in heated solvent (2). Influence of temperature and solvents.** Nakada, Masao; Sakaki, Tsuyoshi; Arita, Seiji. (Government Industrial Research Inst., Kyushu, Saga, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The degree of swelling (ratio of volume of coal after swelling to that before swelling) of Wandoan coal in a range of the solvent temperature of 50 to 300°C was measured using seven solvents to determine the influence of temperature and solvent on the swelling of coal by hot solvent. The solvent used includes anthracene oil (AO), hydrogenated anthracene oil (HAO), toluene, pyridine, tetrahydroquinoline (THQ) and 1-methylunaphthalene. The variation of degree of swelling with time at various temperatures was measured using AO and HAO. The test results of the swelling by the solvents indicates that the coal begins to swell at 50°C in toluene and pyridine and the degree of swelling by THQ sharply increases at high temperature and that 1-methyl-naphthalene shows the same degree of swelling at 200°C as tetralin. (2 figs, 1 tab, 1 ref)

50508 (FSJ—8601, pp 282-285) **Ionization methods in mass spectrometry of asphaltenes.** Niwa, Yoshio; Ishikawa, Keiichiro; Sugimoto, Yoshikazu. (National Chemical Lab. for Industry, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

The FAB and DEI/CI methods were comparatively investigated to develop a useful ionization method for the molecular-weight distribution and structural analysis of asphaltened. The sample asphaltene (As) was prepared from the toluene-soluble-heptane insoluble in the liquefied product of Wandoan, Battle River and Miike coals. These coals were liquefied at 450°C for 60 minutes under the initial hydrogen pressure of 100 kg/cm^2 using tetralin as the solvent and Fe_2O_3 plus S as the catalyst. The FAB spectrum, FAB link-scanned spectrum and DCI spectrum are presented. Although fragmental ions are observed in FAB and FAB-link scanned spectra, the excitation by the collision dissociating method is insufficient for estimating the structure. Lower molecular-weight components can be sensitively determined by the DEI/CI method though the analysis of high molecular-weight components is limited. (6 figs)

50509 (FSJ—8601, pp 286-289) **Some charcteristics of major inorganic elements in coal.** Kimura, Tatsuo. (National Research Inst. for Pollution and Resources, Ibaraki, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Ten elements such as Sr, Fe, Ti, Ca, K, Cl, P, Si, Al and Mg contained in ten Japanese coals and twelve foreign coals were analyzed by X-ray spectrometry to identify the elements other than C, O, H, N and S in coal. The samples were prepared in such a way that 3000 g each of pulverized coals dried at 107°C for an hour was weighed out and press molded in an aluminum ring. The modified X-ray spectrometry used for the experiment was a modification of the Berman et al's method. The result indicates that Si, Al, Ti and K estimated to be derived mainly from clayey minerals correlate with the ash content and Sr correlates more closely with P than with Ca and that P, Ce and Sr are contained more in the Japanese coals than in the foreign coals, while Cl is contained more in the foreign coals than in the Japanese coals. (2 figs, 2 tabs, 3 refs)

50510 (MMIJ—8801, pp 159-160) **Adsorbed gas in coal seam.** Oga, Kotaro; Higuchi, Kiyoshi; Koizumi, Koichi. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan; The Coal Mining Research Centre, Japan, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Method of measurement and prospecting of the adsorbed gas in the coal seam are not yet integrated. In this experiment, two methods of measuring the gas desorption of the bored coal powder were used; one is the conventional method and another is a newly developed method. From the measurement and the calculation, it was found that Aiery's equation gave the highest amount of the lost gas, then the root t method, then finally the Darcy method. From the viewpoint of safety, Aiery's method seems best at the present time. In this measurement, the maximum gas occlusion was 14.49 m^3 per ton of coal. Measurement by means of gas desorption meter is quite effective for the man-power saving in instrumentation and analysis. (3 figs, 2 tabs, 6 refs)

50511 (MMIJ—8801, pp 161-162) **Consideration on porous body gas permeation model.** Miyakoshi, Hiroshi; Otsuka, Kazuo; Sasaki, Hisao; Hiramatsu, Akio. (Akita Univ., Mining College, Akita, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

There have been almost no reports issued on the mutual gas diffusion behavior of methane and gas in the coal seams with a pressure gradient. This report expanded a model analysis wherein the porous structure of coal was treated as a uniform pore diameter. A complex phenomenon of a gas diffusion in the porous body and the gas permeation caused by the pressure difference is model-analyzed; results of experiment on the mutual gas transfer of methane and air in the molded sample of the pulverized coal are also explained wherein it was clarified that the minute pressure difference greatly influence the transfer of air and the methane gas. (9 figs, 1 ref)

50512 (MMIJ—8801, pp 163-164) **Gas permeation test by hollow cylinder test.** Goto, Ken; Kono, Sizuo; Takada, Nobuo. (Kyushu Univ., Fukuoka, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Evaluation of gas permeability through the coal seems or the extent of crack generation is needed for the gas emission, gas purging or for the prevention of spontaneous ignition. However, the measurement on site involves various difficulties. A radical permeability test was conducted using a hollow cylindrical sample as an on-site testing of coal column crack by the press-in of a gas. The method is as follows; A 6 mm round hole is opened in the center of a column with 40 mm diameter and 60 mm height. Gas pressure is applied here, and amount of gas flowing out of the periphery is measured with a soap-film flow meter. Flow-out condition of gas from the sample periphery is examined by coating a soap solution on the periphery, and the flowing crack is sealed to measure the change in the filtrability. Relation between the pressure velocity and the gas flow quantity of the pressurized gas container of a constant volume was examined. (3 figs, 1 tab, 2 refs)

50513 (MMIJ—8801, pp 399-400) **Free silicates in coal.** Iwasaki, Takashi; Nagoya, Shunji. (Waseda Univ., School of Science and Engineering, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining Metallurgical Inst. of Japan.

The content of free silicates in coal was determined quantitatively. Five types of coal were ground to powder and heated to ash to prepare two specimens. The specimens were analyzed by the modified phosphate method and the X-ray diffraction and addition method. In the former method, a standard technique (specified in the work environment measurement guidebook) was used to analyze the specimens; the results were multiplied by the ash content in the specimen to determine the content of free silicates. In the latter method, a specific quantity of coal was added to the specimen; the weight ratio of free silicates to the specimen before addition was determined according to the increase in the intensity of diffracted X-rays. The results of the two analysis methods were compared. The findings are as follows: (1) The content of free silicates in all specimen except the specimens with a particle size of 44 μm or less is 1% or less. (2) The specimens contains a considerable amount of amorphous quartz. (3) Coal contains free silicates at about 1% regardless of analysis methods. (1 fig, 6 tabs)

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REFER ALSO TO CITATION(S) 50349, 50350, 50351, 50355, 50387, 50504, 50580, 50586, 50594, 50595, 50597, 51796, 52071, 52080

50514 (CRIE—485007) **Study on the use of coal ash reclaimed land as a upland-fields (Part 2). Relation between the crop growth and depth of covered soil on fly ash layer.** Okabe, Katsumi; Suganuma, Hirotoshi; Aoki, Masanori. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1987. 19p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752072/JAW.

When coal ash reclaimed land is used for upland-fields, agricultural soil covering on the coal ash layer is required to perform efficient crop cultivation. In this study, Japanese radish and rakkyo are planted in soil covering on fly ash packed in boxes, which are

placed outdoors. The depth of soil covering is 20, 30 or 40 cm. It is revealed that the main root length and edible root length decrease with decreasing depth of soil covering. In the 20 cm-deep soil covering, in particular, heteromorphic roots such as L-shaped ones were produced. The yield tends to decrease with decreasing depth of soil covering. The effect of depth on Japanese radish is small while that on rakkyo is large. Boron and molybdenum contents were higher in leaves of plants cultivated in thinner soil covering layers. This may be due to the absorption of these substances from the fly ash layer under the soil covering. It is concluded that optimum depth of soil covering to produce good upland-fields is more than 30 cm for Japanese radish cultivation while a thicker soil covering layer may be required for plants that need a longer cultivation period, such as triennial rakkyo. (7 figs, 11 tabs, 4 refs)

50515 (DOE/METC—87/6082, pp 1-8) **Reduced entrainment precipitation (REP) for high-temperature and high-pressure (Phase I).** Furlong, D. (ETS, Inc., Roanoke, VA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC01-86ER80343.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

A concept which has potential application for particulate control in advanced combustion systems such as pressurized fluidized beds is the reduced entrainment precipitator (REP). In an electrostatic precipitator, particles once captured, do not necessarily remain captured. Solid particles, especially those with low resistivity properties, are only lightly held to the collecting plate and can be easily dislodged by the gas flowing by the plates. The REP limits this re-entrainment by the use of porous collecting plates, allowing a bleed stream of clean gas to flow through and thus exerting an aerodynamic force on the collected particulate. The overall technical objective of Phase I was to demonstrate the particulate removal capability of the REP and to determine the technical feasibility of applying the REP to HTHP processes. Test results apparently show that the REP can provide significant improvements in the particulate removal efficiency of an ESP. In-depth analysis of the data, beyond the scope of the present effort, would be necessary to confirm this. The improved efficiency was not found to depend on the particulate resistivity. Hence it is predicted that similar improvements should also occur at HTHP conditions. A very preliminary economic analysis suggests that the REP should be less costly than either a HTHP ESP or a HRHP fabric filter.

50516 (DOE/METC—87/6082, pp 20-27) **Testing of electrostatic precipitator at New York University.** Kumar, K.S.; Feldman, P.L. (Cottrell Environmental Sciences, Somerville, NJ (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21094.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The electrostatic precipitator testing and evaluation program at New York University's PFBC test facility was initiated in November 1986. The objective was to determine its particulate collection efficiency at the combined cycle PFBC exhaust conditions of 1650°F and 10 atmospheres. The nominal gas flow to ESP at these conditions was typically 1200 acfm. The electrostatic precipitator was of the horizontal flow plate type such as that used in conventional utility power plants. Though previous sub-pilot scale tests were performed with tubular ESP geometry, both engineering design and economic analysis pointed towards horizontal flow plate type geometry for the 100 MW commercial size modules for utility application. However, the concept of packaging plate type ESP's in horizontal flow pressure vessels was new for this application and needed engineering development. Tests and observations from the tests are described.

50517 (DOE/METC—87/6082, pp 152-159) **Electrochemical abatement of pollutants NO/sub x/ and SO/sub x/ in combustion exhaust gases employing a solid-oxide electrolyte.** Mason, D.M. (Stanford Univ., CA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The purpose of this investigation is to test the feasibility of electrochemically pumping off oxygen from pollutant species: NO/sub x/ and SO/sub x/ rendering NO/sub x/ harmless and forming easily condensable sulfur from SO/sub x/. It is desired preferentially to reduce the pollutant species without having to pump any excess oxygen that may be present. The relative electrocatalytic reactivity of pollutant species compared to oxygen will be experimentally determined. Initially a thorough understanding of O_2 electroreduction kinetics is being obtained before studying NO and NO/O_2 mixtures. An oxygen-ion type solid electrolyte composed of Y_2O_3-stabilized ZrO_2 is being used in a disk-shaped differential flow reactor to study the electrocatalytic pumping off of oxygen from the pollutant species found in combustion exhaust gases. The mechanisms for electro-catalytic kinetics as well as for surface diffusion rates are being investigated. Experimental methods are preliminary results are discussed.

50518 (DOE/METC—87/6082, pp 160-164) **Super-equilibrium sulfur removal from high temperature gases.** Jeong, K.; Stickler, D.B. (Avco Research Lab., Inc., Everett, MA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23262.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

Based on availability and cost, the potential of calcium based sorbents to control sulfur emission appears to be attractive. A number of alkaline and alkaline earth-based compounds have been used as sulfur getters. However, calcium based sorbents operate at temperatures of 1200-1500K, while most of coal processes operate at much higher temperatures. Unfortunately, above 1500K the thermodynamic capacity of calcia to retain sulfur in the solid form decreases rapidly, and is almost zero at about 2000K. The objective of this program is to investigate the potential of chemical sorbents for sulfur removal from high temperature gases (1600-2400K) under transient thermal nonequilibrium conditions. While thermodynamic equilibrium sulfur capture is essentially zero for a fuel-rich mixture at these high adiabatic gas temperatures, the proposed super-equilibrium method is based on the premise that retention is dependent on the particle temperature rather than the gas temperature. The scope of this work is to determine, from single pulse experiments, the effects of various sorbent properties and coal combustion conditions on sulfur capture. Results to date are summarized.

50519 (DOE/METC—87/6082, pp 165-169) **High temperature interaction of SO_2 with oxide sorbents.** Seehra, M.S.; Thevar, G.R. (West Virginia Univ., Morgantown (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23259.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The major goal of this project is to obtain detailed data on the kinetics of surface species formed during the high temperature interaction of SO_2 and O_2 with MgO and calcined dolomite. Similar studies are also planned in the reducing atmosphere of H_2S because of the equivalent technical importance of this problem. The program involves the simultaneous use of Electron Spin Resonance and FTIR Spectroscopies and a high vacuum system in which controlled amounts of gases are introduced at selected temperatures up to 700°C. Thus in-situ detection of the surface chemical species, their transformation modes and kinetics are to be studied. The importance of these results in relation to the advanced coal-use technologies will also be examined. Equipment has been set up and preliminary ESR experiments on MgO and dolomite have been completed.

50520 (DOE/METC—87/6082, pp 170-173) **SO_2/H_2S reactions with calcium-based sorbents.** Cook, J.M. Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

A knowledge of the fundamental chemistry of the reactions of sulfur dioxide with sorbents is the overall goal of this project. Specifically, studies are being conducted to determine the kinetics and mechanisms that occur during the initial states of reaction. X-ray photoelectron spectroscopy techniques will be used to obtain

experimental data that will provide the means of determining this understanding. This information will be of use in evaluating theoretical models, such as the Pore-Tree Model developed by Gerald Simons of PSI, and will also permit the calculation of rate constant values that can be used in theoretical models as a means of applying them to real world systems. Additional relevant information will be obtained through the use of a packed bed flow reactor which will produce sulfur utilization data based upon the controllable input parameters, such as initial porosity, internal surface area, temperature, and sulfur dioxide partial pressure. Depth profile studies will be conducted as a means of determining the depth of penetration of sulfur into the sorbent particle and the penetration depth of the oxidation of the sulfur in order to check on the environmental disposability of the resultant ash. Similar type of studies will also be conducted with H_2S as the sulfur gas source as a means of investigating in-bed sulfur capture. Model studies will be used to determine the sorption in the various zones within a fixed-bed gasifier.

50521 (DOE/METC—87/6082, pp 182-192) **Mechanisms for hot gas cleanup.** Cook, J.M.; Siriwardane, R.V. Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

Calcium-based sorbents are used for sulfur capture in both combustion and gasification applications. A knowledge of the fundamental chemistry of the reactions of sulfur-bearing gases, such as H_2S and SO_2, with calcium-based sorbents is the main goal of this project. X-ray photoelectron spectroscopy (XPS) techniques are being used as the main avenue of approach to determining the experimental data that will be used as the means of obtaining a basic chemical understanding. The experiments are conducted over a temperature range of 25° to 1000°C and are being performed on high purity, single crystal surfaces. Theoretical models which simulate the reactions of sulfur-bearing gases with porous sorbent particles are being used to extrapolate reaction information obtained under high vacuum conditions for comparison with sorbent performance under process conditions. Depth profile studies in conjunction with the XPS experiments on the reacted surfaces will be utilized as the means of determining the depth of penetration of sulfur into the sorbent particle, as well as the penetration depth of the oxygen. The oxidation of the sulfide to the more stable sulfate is important from an environmental viewpoint since the sulfur that remains in the ash that is removed from the bed must be in a stable form for disposal. One project goal is to determine what, if any, environmental problems might result in the disposal of this ash and to determine methods of dealing with them. Additional sulfur utilization data, based upon controllable input parameters (i.e., initial porosity, internal surface area, temperature, etc.), using micronized CaO and naturally occurring limestones/dolomites may be obtained through the use of a variety of techniques, such as differential flow reactors, packed-bed reactors, and/or volumetric gas sorption systems. 18 references.

50522 (DOE/METC—87/6082, pp 193-197) **Throwaway processes for treatment of regeneration tail gases.** Bodek, I.; Woodland, L.R. (Arthur D. Little, Inc., Cambridge, MA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23086.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The goal of this program is to evaluate processes for treating the regeneration tail gas from a high-temperature desulfurization process (zinc-ferrite process) used in coal gasification applications. A second objective of this test program is to collect sufficient data to allow incorporation of the test results into a conceptual full-scale design for comparing the economics of the non-recovery processes with the recovery processes under development. The two FGD process concepts which will be investigated in the bench-scale test program are the spray drying and dual-alkali processes. Although these two technologies have already been demonstrated on commercial and/or pilot plant scale for coal-fired generating stations, they are presently operated under much different conditions than required for this application. They are normally used for much lower sulfur dioxide concentrations; and in most cases, at lower temperatures and atmospheric pressure. A description of the project is given. Equipment has been fabricated and is ready for testing.

50523 (DOE/METC—87/6082, pp 198-202) **Sorbent-based recovery of sulfur from regeneration tail gases.** Harkins, S.M.; Gangwal, S.K. (Research Triangle Institute, Research Triangle Park, NC (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-86MC23260.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

This project is to develop a process for the conversion of hot gas desulfurization off-gases containing approximately 1% SO_2 to a suitable Claus plant inlet gas containing 10 to 50% H_2S at high pressure and temperature. The process will employ a regenerable alkali metal based sorbent with appropriate structural integrity, reactivity, capacity, and mechanical strength. In the proposed process, a regenerable alkali based metal sorbent is used to remove the SO_2 at 650-725°C from the regeneration tail gas. The cleaned tail gas can then be recycled to regenerate additional zinc ferrite. The alkali sorbent is then regenerated with hot coal gas (or H_2) at 700-725°C to produce a hot H_2S-containing gas suitable as a Claus plant feed. A project description is given and results to date are summarized.

50524 (DOE/METC—87/6082, pp 203-214) **Sulfur recovery from hot coal gas desulfurization processes.** O'Hara, J.B.; Chow, T.K.; Findley, J.E. (Ralph M Parsons Co., Pasadena, CA (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract AC21-84MC21097.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

A high potential version of the METC Hot Gas Cleanup Program consists of high temperature chemisorption of sulfur compounds on a chemically active solid sorbent such as zinc ferrite. The sulfided sorbent can be regenerated for reuse by contact with an air-diluent mixture at 1000-1350°F to produce a regenerator offgas containing 1.5 to 5.0 mole percent SO_2. For environmental reasons, this offgas must be processed to eliminate the SO_2 before being released to the atmosphere. This project defines procedures, and projected economics, for converting the SO_2 to salable elemental sulfur. Results from the preferred process selection, experimental testing, conceptual designs, and economic evaluation are given and discussed. 5 figures, 8 tables.

50525 **(ECN—88-021) Lixiviation of fly ash.** Verhagen, L. (Netherlands Energy Research Foundation, Petten). Jan 1988. 86p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The lixiviation of a number of elements (Na, K, Ca, Mg, V, As, Sb and Hg) from different fly ash products (fired and cement bounded products) is investigated. A theoretical description of diffusion from a fly ash product is given as well as a standard test to determine the lixiviation rate. Lixiviation can be interpreted as a diffusion process. Diffusion of an element X from a fly ash product can be described with the following parameters: the effective diffusion coefficient, the fraction that is available for lixiviation and the tortuosity of the product. The physical meaning of the determined tortuosity is not clear. The behavior of tracers in the product is compared with the behavior of the corresponding element. Often this behavior deviates, sometimes even considerably. From a comparison of fly ash products it appears that cement bounded products are better able to combine with arsenicum and antimony than fired products. None of the investigated products caused concentrations of micro-elements way above the stated norm. Improvement as for lixiviation behavior of the products seems to be possible, in particular for bricks. 8 refs., 17 tabs., 26 figs.

50526 **(ECN—88-098) Catalytic NO/sub x/ reduction.** Tuenter, G.; Muller, H.G.; Snepvangers, L.J. (Netherlands Energy Research Foundation, Petten). Jun 1988. 12p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the CEC contractors meeting on flue gas treatment, fly ash properties, re-use and disposal, Brussels, Belgium, 16 June 1988.

The aim of the project is to evaluate the perspective of a modified selective catalytic reduction process to reduce NO/sub x/ emissions from flue gas. In a previous study the activity of the equi-

molar NO/NO/sub 2/ reduction was found to be higher than the NO reduction. The modified process is based on the equimolar NO/NO/sub 2/ reduction. NO, being the predominant NO/sub x/ component in flue gas from stationary sources, must then be partly oxidized to NO/sub 2/. A desk study is carried out to review the literature on methods for flue gas composition modification with respect to the NO/NO/sub 2/ ratio. The evaluation of the modified SCR process also requires more knowledge about the increase in catalytic activity of the equimolar NO/NO/sub 2/ reduction as compared to the NO reduction and about the effect of catalyst composition on the reaction rate. In order to investigate these aspects, an experimental programme is carried out, using four different catalyst materials; two commercial preparations and two self-prepared vanadium-titanium dioxide catalysts. The results of activity measurements for NO, NO/sub 2/ and the equimolar NO/NO/sub 2/ reduction are reported, under conditions relevant for large scale applications. From these results some preliminary conclusions can be drawn with respect to the perspective of the modified process. 7 figs., 6 refs., 5 tabs.

50527 **(NEI-DK—93) Heavy metals from coal combustion. Occurence, reactions and release.** Dalager, S.; Mosbaek, H.; Holst Soerensen, L.; Hesselbjerg Christensen, N.; Stoholm, P. (dk-TEKNIK (DK); Risoe National Lab. (DK)). (DK-Teknik, Soeborg (Denmark); Risoe National Lab., Roskilde (Denmark)). Dec 1987. 123p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754407/JAW.

The report is a survey on the behaviour and fate of trace elements on their way through a pulverized coal-fired low NOx dry bottom boiler with dry slag removal, high dust SCR equipment, a cold side electrostatic precipitator and a flue gas desulphurization plant using lime as sorbent. The report is dealing with semidry as well as wet scrubbing. Mass flow balances and emission rates are estimated for the Danish power plants as a whole. Emissions to the atmosphere are evaluated and compared to other emission sources. The work forms the potential basis for supplementary measurements and the derivation and verification of a mass balance model. 111 refs.

50528 **(SNV—3144) Deposition of waste products from coal and peat firing. Instructions.** Lundgren, T.; Elander, P. (Statens geotekniska institut, Linkoeping (Sweden)). (National Swedish Environmental Protection Board, Solna; Statens Geotekniska Inst., Linkoeping (Sweden); KVM, Kraft- och Vaermeproducenternas Samarbetskommitte foer Miljoefraagor, Stockholm (Sweden)). Jun 1986. 131p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754425/JAW.

The instructions were prepared to facilitate for the heat and power producers their planning and accomplishment of residual products deposition. Strictly, handling of waste products from merely coal and peat firing is described. Other kinds of combustion residues i.e. wood and refuse ashes are in some respects equivalent with these products, therefore the instructions may be valid also in those cases. (G.B.).

50529 **Promising advanced coal preparation technologies for reducing SO_2 emissions.** Hucko, R.E.; Gala, H.B. (Pittsburgh Energy Technology Center, PA (USA)). pp 211-215 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

In 1987, the US Department of Energy's Pittsburgh Energy Technology Center (PETC) completed a major study, termed the Acid Rain Control Initiative Study. With the help of a number of extensive data bases that include exhaustive sets of data on the nation's coal resource and utilization base, the 1985 national population of coal-fired electric utility boilers was analyzed, level of SO_2 emissions from these boilers were calculated, sources of coal that are major contributors to the total SO_2 emissions were identified, and several coal preparation and flue gas desulfurization processes were analyzed with respect to their fit as near-term control strategies for SO_2 emissions. The Acid Rain Control Initiative Study was divided into three subgroups, namely, Coal Resource and Utility Plant SO_2 Emissions Characterization (1), Coal Preparation (2), and Flue Gas Emission Control (3). The broad objective of the study was to identify the most economic combination of near-term (ready for commercialization by 1992) precombustion (coal preparation) and postcombustion (flue gas desulfurization) processes that are capable of controlling the emissions of SO_2 from the utilities that were identified as major contributors to the total SO_2 emissions in the US.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 50344, 50346, 50372, 50484, 50527, 52156

50530 **(ECN—88-106) Waste/soil interaction studies. The leaching of molybdenum from pulverized coal ash.** Van der Sloot, H.A.; De Groot, G.J.; Hjelmar, O. (Netherlands Energy Research Foundation, Petten). Jun 1988. 26p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In this work the leaching of molybdenum from pulverized coal ash is addressed to illustrate the similarities between a number of leach test procedures. It highlights the usefulness of the different methods in obtaining information to assess the release and fate potentially hazardous components from waste materials in the soil system. For this purpose, column leaching tests, batch extraction procedures, lysimeter measurements, diffusion measurements, measurements of the interaction at the waste/soil interface and migration measurements at low percolation rates have been carried out. The combined information from these methods leads to a more detailed insight into the factors relevant to the impact assessment of undesirable components from combustion residues. The sequence of diffusion, interface interaction and migration measurements using radiotracers yields valuable information about the behavior of the stable elements, which is difficult to gain from conventional techniques. The simplicity of the procedure and the versatility in studying the influence of variations in relevant parameters (e.g. pH, complexing capacity, redox) offers a great potential in tackling the complex phenomena occurring in waste/soil systems. 12 figs., 26 refs., 4 tabs.

50531 **(TNO-PML—1985-C54) Development of a tracer aerosol generator. Part 2: Final report.** Oeseburg, F. (Prins Maurits Lab. TNO, Rijswijk (Netherlands)). Dec 1985. 60p. (In Dutch). Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk, Netherlands.

A device for the generation of monodisperse solid aerosols (tracer KNO/sub 3/) was constructed within the framework of the project 'Fugitive dust' (OWS). This generator will be used in experiments to determine the sampling efficiency of solid aerosols in ambient air of a number of samplers. The generator contains a spinning disk ('Micro-Ulva') which is placed at the bottom of a vertical pipe. The sprays generated by the 'Micro-Ulva' and consisting of a solution of KNO/sub 3/ in water are transported by means of a heated airflow through the pipe. The solid aerosol forms upon the evaporation of the water. Experiments were carried out in order to establish whether the particles leaving the stack were solid in actual fact. This appeared to be the case. Moreover it was found that the particles were more or less spherical and often porous. Particle size distributions of the tracer aerosol were determined by means of a microscope. The samples were obtained with the help of rotorods coated with vaseline and an isokinetic filter sampler. The tracer aerosol turned out to be fairly monodisperse. Satellite particles were observed during the generation of particles using relatively high solution strengths (10% w/w). The mean particle density was determined using a technique in which millipore membrane filters loaded with KNO/sub 3/ aerosol were subjected both to a microscopic and a chemical analysis. The aerodynamic diameters were calculated starting from the microscopic diameters and the mean particle density. An estimate for the maximal systematic error in these diameters was made. The primary source strength of the generator was determined by means of a chemical analysis of KNO/sub 3/ collected on filters. Finally it was concluded that the tracer aerosol generator meets the requirements and could be used fruitfully in the project 'Sampling efficiency of the human being and of mass monitors for course dust in the ambient air (part 2)'.

50532 **(TVA/ONRED/WRF—88/2) Constructed wetlands for treating acid drainage at TVA Facilities: Progress report.** Tomljanovich, D.A.; Brodie, G.A.; Hammer, D.A. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Mar 1988. 145p. NTIS, PC A07/MF A01. Order Number DE88016102/JAW.

A comprehensive overview is presented of TVA's use of constructed wetlands to naturally treat water quality problems associated with acid drainage at its fossil plants and the inactive Fabius Coal Mine and Preparation Plant in Jackson County, Alabama. TVA constructed its first wetland in May 1985. As of December 1987, a total of eight constructed wetlands, one enhanced natural wetland receiving acid drainage, and one former chemical treatment pond were being monitored as treatment wetlands. Some measure of success is being achieved at all the wetland systems. However, to achieve compliance quality effluent (total Fe <3.0 mg/L, total Mn <2.0 mg/L, pH 6.0–9.0 s.u., and total suspended solids <32.0 mg/L) interim chemical treatment is being used at COF to treat manganese, and at WCF to treat low pH. At KIF, water is being pumped from the final cell of the wetland to the active ashpond as an interim measure until it is shown to consistently yield compliance quality effluent. Chemical treatment is also being used to augment wetlands treatment at the Fabius Impoundment 2 and Impoundment 4 wetlands. Where chemical treatment is required, reduced chemical costs result from some level of wetlands treatment. Successful wetlands treatment has been demonstrated at three sites, where no chemical treatment is required. In the remaining two newly constructed wetlands, insufficient data exist to assess their treatment capability. Overall average construction cost based on nine wetlands was $1.13/ft^2 ($49,223/ac). Before converting one chemical treatment pond (Fabius Impoundment 3) to a wetland, TVA was annually spending $12,000 to $15,000 for chemicals and $10,000 for pond maintenance that failed to maintain complying discharges. Complying discharges and an annual wetland maintenance cost of about $1000 make the wetland an attractive and cost-beneficial treatment method. 2 refs., 15 figs., 10 tabs.

0110 Reserves And Exploration

50533 **(KTM/E-D—148) Chemical mapping of peatlands with a special emphasis on the energy production.** Peuravuori, J.; Pihlaja, K. (Turku Univ. (Finland). Dept. of Chemistry). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jan 1988. 165p. (In Finnish). NTIS (US Sales Only), PC A08. Order Number DE88754403/JAW.

Chemical mapping of the organic materials in peatlands increases our fundamental knowledge about the alternative uses of peat resources, especially about the possibilities to refine peat chemically. The mapping of the inorganic components of peat helps the evaluation of their concentration levels and regional distribution. The main aim of the chemical mapping of peatlands and the determination of inorganic and organic (mainly humic substances) constituents in their run-off waters has been to create a better approach for estimation of environmental impacts of the peat production. The following quantities have been determined for various geographically and botanically different peatlands using vertical sampling (in 20 cm columns) from top to bottom: the concentrations of the most usual inorganic constituents (Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn, Al, Si, Mo, Ti, V, Mg, Ca, Sr, Ba, P, N, S, As, Cd, Th and U); from the organic material: the contents of lipids, waxes, humines, humic acids, fulvic acids, and water soluble organics; from the general parameters: pH, water content, ash content, the degree of humification and volume weight, and botanical classification of the main peat factors. The concentration of the same inorganic components were determined both from peat and the run-off water. The optimization of sampling is heading towards a possibility to evaluate, within reasonable expense, the level of contaminants and other chemical factors in a peatland for potential utilizations of peat. If successful the above model will not be applicable only to the prediction of environmental impacts but also to control mixing of various mass flows.

50534 **(QMEGME—86) Physico-chemical properties of middle Quebec peat in view of industrial uses.** Buteau, P. (Quebec Ministry of Energy and Geological and Mineral Exploration, Ste-Foy (Canada)). 1986. 64p. (In French). (MICROLOG—88-03624). CANMET/TID, Energy, Mines and Resources Canads, 555 Booth St., Ottawa, Ont., Canada K1A 0G1.

A survey of 35 middle Quebec peat deposits has been conducted with a view towards characterizing the different types of peat found there. The choice of chemical analyses has been guided first of all by the potential use of the peat for energy purposes. The uses based on their chemical properties, as well as uses for agricultural purposes, have also been taken into consideration. The 35 peat deposits surveyed are grouped into 8 morpho-climatic regions. For each deposit, its location, physical and ecological characteristics, or even more, its present utilization, is summarized. Each presentation is followed by a map of the deposit which shows the location of the sites sampled. A table gives the thickness of the deposit and specifies the decompositional state of the material according to the Van Post scale. As for the analytical data, they are grouped into eight tables inserted at the ends of chapters. Analyses have been done of ash, total S, CaO, Fe/sub 2/O/sub 3, P/sub 2/O/sub 5, total N, wax, greases, water retention, and circulable H+, Na, K, Ca, and Mg. In the discussion at the end of the report, it is noted that the results of the analyses allow a clear overview of the local and regional variations. The local variations are connected to the state of decomposition of the peat, while the regional variations are explained by the morpho-climatic environment in which the deposits are developed. 28 refs., 40 figs., 41 tabs.

0120 Mining

REFER ALSO TO CITATION(S) 50603, 50604

50535 **(IC—9173) Investigation of dust sources and control technology for longwall plow operations.** McClelland, J.J.; Jankowski, R.A. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 10p. US Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

The Bureau of Mines conducted a study of longwall plow operations to identify dust sources and existing control technology. Three longwalls employing either the high-speed overtaking or conventional method of mining were surveyed. Principal operating parameters and on-site dust control technology at the time of each survey are described. Short-term gravimetric and instantaneous sampling results are discussed in detail. The relationship between longwall dust levels and dust control technology was examined.

50536 **(IC—9179) Probe-hole drilling: High-stress detection in coal.** McDonnell, J.P.; Haramy, K.Y. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 11p. US Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

Coal mine bounces and bursts are major problems facing U.S. mine operators. Bounces and bursts have the potential to inflict severe injury on mining personnel, damage equipment, and cause mine closures. High-stress conditions, at or near the working face, are the common denominator in the burst problem. If mine operators can locate high-stress and potentially burst-prone zones, they can then use stress-relief methods to control the burst condition. One method of locating the high-stress zone is the probe-hole-drilling or drilling-yield method. Probe-hole drilling is used frequently in Europe, the U.S.S.R., and Japan as a means for locating potential burst zones. Consequently, the Bureau of Mines performed tests in the laboratory and in a deep, burst-prone western mine to analyze probe-hole drilling. The in-mine method, very simply, involves drilling a hole into the coal seam and measuring the volume of cuttings obtained. A certain volume of cuttings can be expected from a certain diameter and length drill hole. A significant increase in the volume of cuttings means the zone around that particular hole is highly stressed. In-mine use of the drilling yield method has shown it to be a useful tool for locating highly stressed and potential burst zones. Results from laboratory testing confirm that high stress applied tri-axially to a cube specimen will cause a

significant increase in the volume of cuttings from a small-diameter drill hole in the specimen.

50537 (IC—9181) **Coal extraction, transport, and logistics technology for underground mining.** Evans, R.J.; Mayercheck, W.D. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 81p. Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

The Bureau of Mines is sponsoring a variety of long-term, high-risk research to advance state-of-the-art technology in U.S. underground coal mining. This report reviews the status of many Bureau projects that support fundamental underground coal mining operations; the project areas include cutting coal from the solid (extraction), hauling coal from the face (transport), and activities that sustain daily operations (logistics). Innovative equipment and technology have been developed, with these major objectives: to significantly improve coal mine productivity, to further advance coal recovery and personal safety within the mining industry, and to reduce the time needed to develop longwall panels. The majority of the prototype equipment covered in this report either has undergone or will undergo comprehensive evaluation at Bureau surface test facilities so that performance and reliability can be improved before the equipment is tested and evaluated in a working section underground.

50538 (MMIJ—8801, pp 123-124) **Hygroscopic swelling of coal bearing formation (part 2). Swelling pressure.** Ichinose, Masatomo; Uchino, Ken'ichi; Murakami, Fuminori. (Kyushu Univ., Faculty of Engineering, Fukuoka, Japan; The Coal Mining Research Centre, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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In order for the maintenance of the headway or top and bottom front, grasp of the dynamic properties of the peripheral rocks, i.e., the coal bearing formation, is important Strength of the Japanese bearing formation is not enough and is easily affected by water. As spring water is abundant in the Japanese coal mines, this report describes on its hygroscopic swelling especially the swelling pressure. Two types of measuring instruments were employed. One is an Alpan type and another is one which measures the swelling along one direction only under a certain load. The sample coal was a shale supplied from Mitsubishi Coal Mining Co. (Takashima coal mine). According to the hygroscopic swelling pressure of the coal bearing shale was measured, which was between several tens kg/cm^2. As there are many speed-up plans for the tram transportation in the gateway, especially accurate rail maintenance is required. (7 figs, 6 refs)

50539 (MMIJ—8801, pp 157-158) **Gas permeability of coal at three axes stress (part 2).** Matsuo, Yusuke; Oga, Kotaro; Higuchi, Kiyoshi. (Hokkaido Univ. Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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When considering a gas transfer in the coal seams, the gas permeability changes according to the change of stress at the periphery of the front. Authors measured the gas permeability of coal under the tri-axes stress in 1987. In the experimental unit, pressure container is a cylindrical axis-pressure separation system with 120 mm diameter and 114 mm height. Permeating gas is supplied from a nitrogen bomb. Coal sample was supplied by Taiheiyo-mine's major seam. Measured items were as follows: Relation between the gas permeability, at 3 axes compression test with sealing pressure of 10 kg/cm^2, and AE by the lapse of time. Stress-strain diagram. Relation of AE count rate and gas permeability. Relation of axis strain, at seal pressure of 100 kg/cm^2, and gas permeability. The system and the sensor used are higher in the accuracy of measurement, but yet there are rooms of improvement. (4 figs)

50540 (MMIJ—8801, pp 167-168) **Effective utilization of wheel wind in the coal mines.** Tominaga, Yusaku; Kon, Naoyuki. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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1. For a model of ventilation network of domestic coal mines, ventilation calculation was conducted, and a computer simulation was made on the generation of a wheel wind in a circuit containing a coal cutting front by installing a local fan. 2. In the case that the ventilation quantity is at stationary state because of a wheel wind, gas concentration of the front exhaust and the front inlet air converges into a certain value. 3. Gas concentration of the front inlet air, when ventilation is in the state of wheel wind, is expressed by a value wherein the gas concentration of the front exhaust is multiplied with ratio of wheel wind in the front inlet air. 4. When the ventilation is well controlled, the increase of gas concentration by wheel wind converges into a fixed value indicating no extreme condensation. (6 figs, 2 tabs)

50541 (MMIJ—8801, pp 169-170) **Measurement of rock pressure phenomena in the neighborhood of long wall type coal mining site. Case study of Minami-Oyubari Coal Mines.** Fujii, Yoshiaki; Taniguchi, Masataka; Konno, Masahiro; Ishijima, Yoji. (Muroran Inst. of Tech., Muroran, Japan; Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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At Minami Oyubari Coal Mines, the following measurements are conducted in order to predict and prevent the rock burst which corresponds the deepening operation. (1) Rock pressure change in the coal seam (2) Expansion of gateway side walls (3) AE activity The extent of expansion seems related with the rock pressure. No correlation was found between the AE event and the degree of expansion, change in oil pressure, and the rock pressure. In this study, by jointing the measurement of the present position and the numerical stress analysis, an integrated interpretation could be obtained on the size of the side wall expansion. However, this expansion and measurement of the oil pressure variation had nothing to do with the prediction of the AE activity. (5 figs, 1 tab, 2 refs)

50542 (MMIJ—8801, pp 171-172) **Characteristic phenomena occurring directly before the gas outburst. Model experiment of gas outburst.** Ujihira, Masuyuki; Tejima, Yoshihiro; Nakajima, Iwao. (Hokkaido Univ., Faculty of Engineering,Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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As the gas outburst occurs under the action of rock pressure at the deep underground, a model experiment was conducted wherein a mechanical side pressure was exerted on the sample having a hole-gap gas pressure. Even when the gas pressure of the minute hole-gap present inside the material is low, gas projection occurs if a side pressure is applied to accelerate the crack. In the model experiment, characteristics of projection and non-projection cases were tried to be clarfied by measuring the following: Deformation of model materials in the equipment, destruction behavior and the change in the gas pressure in the crack. What has been found is that, just before the occurrence of the outburst, crack gas pressure in the sample rapidly elevates; especially the crack gas always elevates in the range of 3 to several cm behind the sample surface. This elevation is the most conspicuous phenomenon seen prior to the projection. (7 figs)

50543 (MMIJ—8801, pp 173-174) **Condition of rock pressure at coal seam hydraulic crushing test.** Kiyama, Tamotsu; Seto, Masahiro; Narita, Takashi; Nabetani, Hiroshi; Deguchi, Gota. (National Research Inst. for Pollution and Resources, Tsukuba, Japan; The Coal Mining Research Centre, Japan, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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In a coal mine where there exists a danger of disaster caused by a gas standing in a coal seam, it is important how to thoroughly outgas with the limited number of bored holes. This study was conducted in Oct. 1987 wherein the coal seams were excited by the hydraulic crushing to remove the gas efficiently. depth of testing was 850 m underground. This hydraulic crushing test showed that the pulsation of hydraulic pressure and the increase/decrease of temporary hydraulic pressure corresponded with AE event, which showed that the crack-formation does not always proceed stationarily but a distribution suddenly occurs. Crack caused by AE is spread in a surface which is vertical to the direction of the minimum main stress. Direction of stress change of the periphery rocks coincides with that at the hydraulic crushing. (6 figs)

50544 (MMIJ—8801, pp 175-176) **Evaluation of rock Pressure distribution in coal seams by means of torque logging.** Itakura, Ken'ichi; Sato, Kazuhiko; Akiyama, Naoichi. (Muroran Inst. of Tech., Muroran, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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In a deep coal mining panel, prior to the developing of coal face, pressure-release boring is carried out for avoiding the danger of rock burst or gas projection. In this study, the torque and boring velocity of the boring machine at the time of rock pressure boring were continuously measured in order to study the possibility of area distribution in the coal seam. As a result of this torque logging, change in torque and boring work was found reflecting the rock pressure distribution, and was found an effective parameter for the estimation of rock pressure distribution. By this, the estimation of rock pressure distribution will be made more definitely. (6 figs, 5 refs)

50545 (MMIJ—8801, pp 177-178) **Trial making of a pressure gauge using a reflective fiber sensor.** Sasaki, Hisao; Miyakoshi, Hiroshi; Otsuka, Kazuo; Tanaka, Katsuyoshi. (Akita Univ., Mining College, Akita, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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In a closed region of a coal mine, methane gas concentration is rather high; pressure is generally higher than the ventilated area. From the security viewpoint, a pressure gauge is needed wherein minute gas pressure (50 - 100 mm H_2O level) of a highly concentrated methane gas atmosphere can be more accurately and safely measured. In this study, a phenomenon wherein a differentially pressurized diaphragm will deform to form a concave surface is utilized; a change of illuminance by the light-collecting action of this concave surface is detected by a reflective optical sensor; a pressure gauge was trially made based on this principle. Measuring range of two pressure gauges made was respectively at 2200 Pa and 650 Pa level. If the differential pressure given negative (minus), output variation is too small to function as a pressure gauge. Minimum resolution was respectively 10 Pa (1 mm water column) and 5 Pa (0.5 mm water column). (7 figs, 2 refs)

50546 (MMIJ—8801, pp 319-320) **Research on in situ measurment of thermal conductivity.** Inoue, Masahiro; Uchino, Ken'ichi. (Kyushu Univ., Faculty of Engineering, Fukuoka, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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As a basic constant necessary for estimating the thermal environment inside a mine pit or of the underground structure, there is thermal conductivity of the rock bed and in recent years, the necessity of measuring its value in situ has been recognized. The in situ measurement methods are roughly divided into those utilizing cooling (heating) of the rock bed due to the natural conditions and those providing artificially the heat to the rock bed and utilizing its temperature change. The latter is well used since the measurement is done in a relatively short time and is not affected much by the natural conditions. However, since the in situ measurement methods do not examine enough various factors affecting the measured data, the precision of the measured result is not reliable in many cases. In this research, practical problems in measuring in situ the thermal conductivity were studied in analyzing by difference calculus the method using the linear heat source theory. A probe which uses the boring as is as a hole to insert a linear heat source and a probe which was used in being adhered to the wall surface of the head were used and as a result, it was revealed that the measured result could not be guaranteed when the contact was bad and the air entered into the gap. (6 figs)

50547 (MMIJ—8801, pp 333-334) **Generation mechanism of AE which is generated in digging area. Model experiment.** Sato, Kazuhiko; Itakura, Ken'ichi; Takatsuka, Satoshi. (Muroran Ins. of Tech., Muroran, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Rock pressure phenomena such as floor uplift and ceiling falling in, etc. which occur in a digging area are accompanied with acoustic emissions (SE) of various frequencies. Accordingly the measurement of AE is considered to be very important for understanding of the generation mechanism of, prediction and prevention of these rock pressure phenomena. In this research, AE phenomena generated with the advance of the working face were measured by using the method of the strata model experiment and the relative location of the hypocenter vis-a-vis the working face and the generation mechanism of AE were analyzed. This article reports on the result of the above experiments. In other words, in determining the location of the hypocenter, the perpendicular direction was disregarded, the calculation of the hypocenter was limited only in the plane including the sedimentary direction of the strata and the direction of advance of the working face and the analysis of moment tensor was dealt with as a plane problem. Concerning the generation mechanism, the followings were confirmed: 1) Around the working face, it was almost a compression type. 2) In the deep section in front of the face, a double couple type could be seen in addition to a compression type. 3) Concerning the ceiling remained after the digging, a tension type, a compression type and a double couple type were seen. (4 figs)

50548 (MMIJ—8801, pp 335-336) **Simulation concerning frequency dependability of P wave propagation characteristics of cracked rock bed.** Watanabe, Toshiki; Ashida, Yuzuru; Sassa, Koichi. (Kyoto Univ., Faculty of Engineering, Kyoto, Japan). Apr 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Propagation velocity and amplitude of P wave is utilized for the evaluation of the cracked rock bed. These propagation characteristics of P wave are considered to depend upon the frequency of the wave entering into the cracked rock bed or the rock bed including many low velocity thin layers. Consequently, simulation concerning P wave propagation characteristics was conducted by casting the waves of different frequencies into the rock bed model including cracks. This article is a report of its result. In other words, a numerical formula was presented to express a ratio of the displacement of the reflected wave against the displacement of the incident wave (reflection coefficient) and that of the transmitted wave (transmission coefficient) in case when P wave entered vertically into the boundary surface between different media. In addition, the properties of two kinds of media were established, a model in which a low velocity band consisting of alternating layers of both media above existed in one of the above media was prepared

and various calculations were conducted. As a result, it was found inter alia that irrespective of the constant ratio between the properties of the media and the low velocity layers, the velocity of P wave varied depending upon the number of layers and the frequency of the incident wave. (5 figs, 1 tab)

50549 (MMIJ—8801, pp 337-338) **Prediction method of blasting vibrations (part 2). Blasting vibration spectra.** Kaneko, Katsuhiro; Hirata, Atsuo; Tasaka, Tomohiro; Sato, Yasuhiko. (Kumamoto Univ., Faculty of Engineering, Kumamoto, Japan; Nishimatsu Construction Co., Ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Prediction of blasting vibrations is normally done based upon the empirical formula which has so far been known, but the constant values contained in the above formula were provided empirically from the blasting conditions and the ground conditions and the quantitative correlationship between these values and the blasting as well as the ground property values have not well been revealed. These reports No.1 and No.2 deal with the vibration of the centercut blasting during the tunnel digging, propose a simple numerical model representing the mechanism of generation and propagation of the blasting vibration and at the same time examine a method to predict the blasting vibration based upon various ground property values by using the above model. In particular, this report No.1 presents a method to calculate the blasting vibration spectra (hypocenter spectrum, propagation characteristics spectrum and ground amplification characteristics spectrum) which become the essential elements in case when the structural response due to the blasting vibration is examined. Furthermore, as the result of adapting this method to the actual progressing blasting, it was confirmed that the estimated spectrum expressed fairly well the trend of the actually measured spectrum. (3 figs, 4 refs)

50550 (MMIJ—8801, pp 339-340) **Prediction method of blasting vibrations (part 2). Maximum vibration velocity.** Kaneko, Katsuhiro; Hirata, Atsuo; Tasaka, Tomohiro; Omi, Michito. (Kumamoto Univ., Faculty of Engineering, kumamoto, Japan; Nishimatsu Construction Co., Ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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It is known that even in the case where the blasting conditions and the soil conditions are constant, the maximum amplitude of the blasting vibration (the maximum vibration velocity) shows a big fluctuation This means that the blasting vibration is in a sense a probable amount. The authors of this report presented the report No.1 on the same subject in 1988. In this article, however, they examine a method to estimate the maximum amplitude of the blasting vibration using the stochastic method on the basis of the concept of blasting vibration spectra shown in the previous report. In other words, a calculation formula of the maximum amplitude of the blasting vibration using the stochastic method was prepared and through comparison between the estimated value of the maximum vibration velocity using the above formula and the actually measured maximum vibration velocity, it is revealed that the actually measured values are within the range of the fluctuation of the estimated values, thus fairly good estimation is made. In integrating the method of this time and the result shown in the previous report, it is considered to be possible to estimate the spectra and the maximum amplitude of the blasting vibration by a relatively simple calculation using the ground property value. (3 figs, 2 refs)

50551 (MMIJ—8801, pp 341-342) **Dynamic response characteristics of underground cavity. Effects of slack domain and lining.** Kaneko, Katsuhiro; Tanise, Masahisa; Nakamura, Naoaki; Omi, Michito. (Kumamoto Univ., Faculty of Engineering, Kumamoto, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Generally, there is a domain with deteriorated strength, namely a slack domain around a cavity in the rock bed. In such a case, the cavity has peculiar dynamic characteristics due to the effect from the slack domain, shows a certain resonance phenomenon caused by the dynamic external force with the specific frequency and the amplification factor of the displacement of the wall surface of the cavity due to the above resonance is expected to surpass 10 times depending upon the conditions. Concerning the dynamic response characteristics of the underground cavity, the authors of this article reported their research in 1982. However, this article examines analytically the effect provided to the dynamic characteristics of the cavity by the surrounding slack domain and its lining based upon the results of the above research and clarifies the effect of restraining the cavity resonance by the lining. In other words, when an analysis is made assuming the cavity is a cylindrical cavity with a radius of a and taking the case where plane waves enter into the above as an example, as the elastic modulus of the lining is higher and its thickness is bigger, the displacement amplification factor decreases and the resonance frequency increases, but when the thickness of the lining is in the order of 0.02a, its effect is not significant. (5 figs, 2 refs)

50552 (MMIJ—8801, pp 349-350) **Strength characteristics of fly ash plug for sealing headway.** Ishijima, Yoji; Tsuji, Omai; Hirata, Saneo. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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As a method to prevent the blowout of coal seam gas into a headway in a coal mine, a fly ash plug is normally used and its strength design is done on the same conceptual basis of a concrete plug. However, concerning the dynamic response upon receiving the external pressure, a fly ash plug is different from a concrete plug and it is possible that their strength characteristics are different too. In this research, some studies were made on the strength of the fly ash plug based on the strength tests concerning fly ash plugs and the stress analysis of the plugs. In other words, the strength characteristics of both the sample manufactured in a laboratory and the sample taken from the plug construction site were investigated, and the age of plug material affecting its strength and the effect of the cement mixing rate, the occurance of slip and the resistance against the external pressure, and others were studied. As the result from the above study, it was revealed that a design of a 15m long plug with strength of 0.8kgf/cm^2 was well within the safe side and it can be said that a fly ash plug is superior to a concrete plug. (4 figs, 1 tab)

50553 (MMIJ—8801, pp 351-352) **Behavior of mine water affecting a plug at the time of an abnormal flood.** Ishijima, Yoji; Wada, Nobuhiko; Hirata, Saneo; Endo, Yuji; Sugawara, Takayuki. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan; Geological Survey of Hokkaido, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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In an old abandoned mine with the underground structure in which an adit is located at the lowest position of the pit cavity, the mine water is collected in the adit, then led out of the pit, but there are many cases where in the adit near the pit mouth, a flow controlling plug is installed. On the other hand, a natural dam is often formed in the pit cavity due to the collapse of the ceiling or wall and when such a dam is disintegrated, a large quantity of the mine water which was reserved behind the dam flashes down instantly towards the pit mouth causing an abnormal flood accident. In this case, an impact pressure larger than the hydrostatic pressure corresponding with the amount of flood acts on the plug. In this research, a study was made concerning the assessment of the magnitude of the impact pressure based upon mainly a model experiment. A 11.3m long cylindrical pipe of inner diameter of 100mm was deemed as a head and the pipe bottom in its lower part was deemed as a plug. The upper part of the pipe was connected with a bucket via a faucet (a dam in the pit) and the water in the bucket corresponded to the reserved water. Furthermore, the cases when a pressure reduction hole, etc. were installed and not installed were

provided. From the result of the experiment, a formula; F=r/g*2(A/2)V was obtained. (F:impact pressure, r:unit volume weight of the fluid, A:cross section and v:flow speed.) (5 figs, 1 tab)

50554 (MMIJ—8801, pp 353-354) **Deformation behavior of gallery by machine excavation.** Matsui, Kikuo; Takahashi, Akihito. (Kyushu Univ., Faculty of Engineering, Fukuoka, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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A study was made on the deformation behavior of galleries by machine excavation to elucidate the difference in gallery deformations resulting from the load header drilling and the drilling with blasting. Four galleries, A, B, C and D, were drilled. Surrounding base rock in weak base rocks suffered but little damage by blasting. When the surrounding base rocks are hard with no crack and the same type of timbering is used, excavation with blasting seems to cause greater deformation as comapared with the excavation by the load header. A logical study on the deformation behavior of galleries revealed that the fitting conditions of the timbering frames had greatly affected the deformation of the galleries. As the result, it became clear that careful attention must be paid to the working of timbering even with machine excavation such as the load header drilling. (4 figs, 2 refs)

50555 (MMIJ—8801, pp 355-356) **Model experiment on gallery deformation in stratified base rock.** Kyo, Haruo; Yamaguchi, Umetaro; Shitaya, Takasai; Mogi, Yoshito. (The Univ., of Tokyo, Faculty of Engineering, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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A Model experiment was performed using model equipment on the deformation of galleries in base rocks with weak stratum. One weak stratum was employed for the experiment in 5 cases according to its relative location to the gallery. When no weak stratum existed, the convergence of the gallery became linearly larger, while the gallery showed strong nonlinear average behavior when a weak stratum existed. The deformation of the gallery was apparently not uniform when a weak stratum existed, with a tendency of the greatest deformation on the roof and the least deformation on the side walls. The cross sectional area of the gallery gradually decreased with the increase in the stress. The fracture experiment using samples showed that the total fracture was induced by the fractured cracks which occurred centering around the weak structure. This indicates that weak strata around galleries greately affects the stability. (3 figs, 1 tab, 2 refs)

50556 (MMIJ—8801, pp 357-358) **Analysis of various measurements made in tunnel.** Ogita, Seiyo; Saito, Toshiaki; Terada, Makoto. (Kyoto Univ., Faculty of Engineering, Kyoto, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Exploring the convergence measurement method which has been most widely used for measurements in tunnels, the analysis method of the measured results was studied. This method can be readily applied to the measurement of the deformation in base rocks. When the cross section of a tunnel can be assumed as a circle and the tunnel is being drilled by the full-size tunneling method, logical analysis of the deformation around the working face can be made comparatively easy. If the cross section of a tunnel can not be assumed as a circle, similar method can be applied by analyzing the deformation near the working face by three dimensional analysis. However, a simpler method is proposed which usilizes the result of a two dimensional analysis. A case was also studied in which the excavation of the lower half considerably delayed and the deformation of the internal space converged at the upper half. In this case, the method mentioned above can be applied until the effect of the lower half is produced. (5 figs)

50557 (MMIJ—8801, pp 359-360) **Mesurement of rock pressure by 3 pair curved jacks.** Goto, Tatsuhiko; Fujii, Yoshiaki; Sato, Tateki; Hosokai, Takao. (Muroran Inst. of Tech., Muroran, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Although there are the oil pressure capsule and pressure cell, they are not necessarily satisfactory. To make up for their deficiency, a measuring instrument is proposed which can measure the physical properties of base rocks without using load material and monitor the two dimensional rock pressure changes in the same bore hole. 3 independent pairs of flat jacks are installed which provide 3 different values of measurement. The measuring instrument is inserted in the measuring position inside the bore hole to get the values of the physical properties of the base rock by pressure-up test, and then it is used as a measuring instrument for rock pressure changes. since it is of a wedge type, it can be used repeatedly. Explanation is made about the principal of this measuring instrument. Comparison of indoor experiment result with theory, and study for its practical application are under progress. (2 figs, 2 refs)

50558 (MMIJ—8801, pp 361-362) **Measurement of rock pressure by lune-shaped flat-jack.** Mizuta, Yoshiaki; Sano, Osamu; Ono, Hiroshi. (Yamaguchi Univ., Faculty of Engineering, Yamaguchi, Japan; Sumitomo Cement Co., ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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A lune-shaped slot was made to employ a measuring method of inserting a matching lune-shaped flat jack, and the stress of the gallery walls was measured by the stress compensation method. The elastic displacement distribution around the slot was analyzed by numerical analysis of 3 dimensional displacement discontinuous method. The general displacement distribution of the slot wall obtained by the analysis is introduced. The general displacement distribution of the gallery walls induced by the cutting of the slot is also presented. Actual measurement by the use of the lune-shaped flat jack was carried out together with measurements by other types of measuring methods. Wall stresses in the vertical and horizontal directions were measured. The record of the stress compensation process is also shown. (6 figs, 1 tab)

50559 (MMIJ—8801, pp 363-364) **Sleeve fracturing and rock pressure (part 2).** Kosugi, Yasunori; Ohara, Yuzo; Sugawara, Katsuhiko; Ishimura, Yutaka. (Kumamoto Univ., Faculty of Engineering, Kumamoto, Japan; Electric Power Development Co., Ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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A two dimensional model experiment was carried out to analyze the law of crack development in sleeve fracturing which occurs when internal pressure is applied to the bore hole through a cylindrical sleeve. The crack developed in the horizontal direction with a little undulation. The crack was on the same plane, and seemed to have developed in lateral symmetry. The relationship of the length of the crack with the internal pressure is given in figures. For $1cm \leqq a \leqq 5cm$, the length of the crack was nearly in proportion to the internal pressure, which well coincided with the theoretical curve in which an assumption was made that the crack developed with a fixed value of the stress extension coefficiency at the head. It was found that, when the internal pressure is increased at a fixed rate, the radial crack develops at almost a fixed rate to the direction of the maximum compression of two dimensional initial stress, the length of the crack is almost proportionate to the internal pressre, and the stress extension coefficiency for the head of the crack takes a fixed value in crack developing process. (6 figs, 3 refs)

50560 (MMIJ—8801, pp 371-372) **Trouble Shooting of gas alarm by expert system.** Sarada, Shigeru; Inaba, Chiyota; Kohler, J.L. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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As the first step of the expert system application to mines, a support system for the maintenance of automatic alarms for flammable gas (hereafter called gas alarm) was developed. The operation of the gas alarm is tested by manipulating the adjusting knob to judge the operational conditions by the resulting movement of the needle. In other words, the manipulation of the knob is the input, and the movement of the needle is the only output. Two methods were employed to obtain the expertise. One was through the operation by experts, their explanation and questions being recorded and arranged in order. The other was to base on the memoranda concerning the maintenance procedure prepared by the experts. Persons having no special knowledge in the gas alarm were employed to test the alarm which had been supported by the expert system. As the result, they perfectly pointed out causes of troubles. In addition, they could very closely locate the points of troubles. (1 fig, 1 tab, 1 ref)

50561 (MMIJ—8801, pp 373-374) **Study on Development of ventilation network analysis system.** Murakami, Fuminori; Inoue, Masahiro. (The Coal Mining Research Centre, Japan, Tokyo, Japan; kyushu Univ., Faculty of Engineering, Fukuoka, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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It is required to develop a system which field engineers can use easily for optimum ventilation control. Development of a basic type of the ventilation network analysis system and its actual application at some of the leading mines are reported. It is a personal computer based system which can be used at any place, with the capacity to analyze data of the ventilation network with 800 joints and 1200 galleries, having a potential of being expanded to the double capacity. The operation is fast with only less than 2 minutes for 100 joints and 200 galleries. Distribution chart of the air quantity can be displayed, and the data can be changed on the display. As the result of the actual application, the system was favorably evaluated as originally planned although there were some requirements for additional functions. (1 fig, 1 tab)

50562 (MMIJ—8801, pp 375-376) **Study on heat transfer in excavation working face space.** Shimada, Sohei; Sugiura, Tetsuo; Omura, Shoji. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Heat environment control in excavation working face is important for both the health of the workers and the efficiency of drilling. Experimental equipment of 1/10 scale model was used to obtain the heat transfer coefficient of the excavation working face space under local ventilation. Hot water was circulated inside the duplex copper tube which was assumed to be a hot temperature base rock. The temperature at the exit of the air pipe was set to 20°C, and that of the water to 38°C and 46°C. The temperature of the blow to the working face was measured by the thermistor set at the exit of the air pipe, and the water temperature by that set inside the duplex copper tube. The temperature of the ventilation was measured by the thermistor temperature system which had been so designed that the measurement can be made at optional cross section. Based on them, heat transfer equations at the static state were obtained. As the result, it became clear that the Nusselt number was proportionate to the 0.9th power of the Reynolds number, having relation with the ratio of the height of timbering. (5 figs, 1 tab)

50563 (MMIJ—8801, pp 377-378) **Durability of coal-bearing formation rocks against water.** Ichinose, Masatomo; Matsui, Kikuo; Uchino, Ken'ichi. (Kyushu Univ., Faculty of Engineering, Fukuoka, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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To make galleries nonflammable or fire-resistant is the fundamental measure for fire prevention in mines. For that reason, the drilled hard material ineviatbly produced in mines must be studied for use as the back filling material. Strength test was carried out with consideration given to the slaking test and effect of water, and the strength of coal-bearing formation rocks against water, namely durability to water, was investigated and studied. The result indicated that nearly half of them caused slaking, and the strength was lowered considerably. These properties much differed according to the locations where the sample rocks were gathered. If this method of working is to be employed, the material rock must at least be tested to see its suitability. Care must be taken with oil shale which has a great slaking property and a tendency of lowering its strength by moisture content. (5 figs, 1 tab, 5 refs)

50564 (MMIJ—8801, pp 379-380) **Fire characteristics of timber frame in inclined gallery.** Komai, Takeshi; Isei, Takehiro. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Fire spreading characteristics of timber frames and variation in ventilation in inclined galleries under upward ventilation were studied by a fire experiment using a model gallery. For the experiment, a model galley with the cross section of 19 x 19 cm and length of 24 m was used which was set at 20° inclination. The peripheral of the model gallery was wound with rock wool heat insulating material in 50mm thickness, and the lower end of the gallery was connected to a sirocco type blower to effect the upward ventilation. At the lower and (windward side), 0.4 liters of gasoline was burnt. Figures are given for the fire spreading speed of timber frames, length of flame band, and the maximum temperature of fire obtined by the experiment in which the velocity of the ventialtion was varied for 0 - 5 m/sec. The fire spreading speed of timber frames under upward ventilation in a gallery inclined at 20° was two to three times faster than that of the case with horizontally set model gallery. Fire did not spread under a certain firing condition in the horizontal gallery with no ventilation, while fire spreaded over the entire length of the gallery in the inclined gallery. (5 figs, 2 tabs, 1 ref)

50565 (MMIJ—8801, pp 381-382) **Flammability test of textile conveyor belt in model gallery.** Nakagawa, Yuichi; Takahashi, Masayoshi. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Reference was made to the draft of the DIN22, 118 standard to study the ignitability and fire propagation characteristic of conveyor belts for use at mines. Equipment was made for the flammability test of conveyor samples to be performed in a small model gallery under ventilation, which was used for the test of textile conveyor belts. Summary of the test method and the test results are reported. The model gallery which can be optionally inclined in the range of 0 - 20° was installed on a frame. The ventilation could be set to horizontal or upward direction. The test results under the horizontal and upward ventilation are shown. It became clear that the ignitability and fire propagation characteristic differed considerably by the difference in the conditions of horizontal and upward ventilation. Some difference in the test results was also observed due to the difference in the types of belts. (7 figs, 3 refs)

50566 (MMIJ—8801, pp 387-388) **Influence of explosion-induced shock wave propagating in tubing on branch tubes and safety.** Shibuya, Takashi. (Hokkaido Inst. of Tech., Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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To obtain road connection data useful for reducing mine explosion disasters, experiments (1) and (2) were conducted using models of shock tubes and roads. Experiment (1) is as follows: The road model consists of a main tube, branch tubes perpendicular to the main tube, a shock wave generating tube connected at one end of the main tube, and people models of metal plates placed at various points in the tubing. The behavior of the people models was observed under the condition of various combination of branch tubes and the closing or opening of tubes at their ends. The distribution of the shock wave to branch tubes and the attenuation involved in such branching were represented in terms of the energy the people models receive. Experiment (2) is as follows: A sliding people model is placed at the end of the shock tube. The behavior of the people model was observed using the schlieren method under the condition that the influence of the branch tubes was eliminated and that the shock wave velocity was varied. The correlation between the shock wave energy and the distance of people model movement was determined. A target of shock wave attenuation was obtained by calculating this correlation. (9 figs)

50567 (MMIJ—8801, pp 391-392) **Quantitative determination of ethylene gas using CO_2 laser.** Yoshida, Yutaka; Hiranuma, Masahide; Sato, Tateki; Goto, Tatsuhiko; Nishitsuji, Akira; Oyama, Junji. (Muroran Inst. of Tech., Muroran, Japan; Hokkaido Univ., Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Study was conducted to serve the purpose of developing a gas concentration meter which will help find gas leakage quickly. The experiment is as follows: Laser light from a CO_2 laser oscillator was injected as modulated light into an optoacoustic cell including ethylene gas to generate an optoacoustic signal from the gas. This signal was detected by a sensor to study the correlation between the signal intensity and gas concentration. Two types of cell were used: a non-resonant cylindrical cell and and an axially resonant cell. The generated optoacoustic signal was fed to a capacitor-type microphone, which indicated the signal in dB. It was revealed that the optoacoustic signal and the gas concentration are in a linear relation on logarithmic paper in the gas concentration range between the orders of ppm and %. It was also found that the laser output should be high and that the cell shape is greatly influenced by (1) resonance characteristics and (2) the distance between the laser light and the microphone. This system will help determine gas concentration in a broad area. (6 figs, 6 refs)

50568 (MMIJ—8801, pp 393-394) **Determination of carbon monoxide with semiconductor gas sensor.** Otsuka, Kazuo; Sato, Isamu; Sato, Hiroshi; Chiba, Harutoshi. (Akita Univ., Mining College, Akita, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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An experiment was conducted to confirm the measurement behavior of a semiconductor sensor which, consisting mainly of tin oxide, is developed for carbon monoxide detection. Two gas passages were introduced into a thermostatic oven; five TGS711's were placed in the oven; a sample mixture of air and carbon monoxide at a constant concentration was delivered into one passage, and air was delivered into the other passage in order to establish an appropriate condition. The sensor response was investigated by observing sensor resistance variations with time. The results have revealed that the sensor resistance assumes a specific value corresponding to the carbon monoxide concentration in the mixture after a certain period of time. The correlation between time and resistance is so high that it can be expressed with a general formula. The minimum time required for measurement with the sensor was also obtained in order to reduce the time needed for measurement. The correlation between the sensor behavior and carbon monoxide concentration is very high. This supports the validity of the theory. (6 figs)

50569 (MMIJ—8801, pp 395-396) **Danger of superfine explosion.** Enomoto, Heiji. (Tohoku Univ., Faculty of Engineering, Sendai, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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To evaluate the danger of superfine explosion, a mist of suspended dust particles consisting of polyethylene (PE) and polystyrene (PS) powder was generated in a sieve gravity type dust explosion test apparatus and was checked to see whether it is ignited by discharge sparking. With PE dust, smaller particle size tends to correspond to lower limit concentration for explosion and lower minimum ignition energy; however, the difference in limit concentration and minimum ignition energy between particle sizes of 30 μm and 50 μm is insignificant. With PS dust, the limit concentration for explosion and minimum ignition energy become lower even when the particle size is 30 μm or less. There is no report about the particle size at which the limit concentration for explosion assumes a minimum. In contrast, the ignition energy assumes a minimum when the causal substance is a gas. The explosion characteristics of dust mist and various factors influencing these characteristics were also studied in an attempt to establish a standard for the danger of explosion. The evaluation scheme using limit concentration for explosion is markedly correlated to the evaluation scheme using ignition sensitivity adopted by the US Bureau of Mines. (5 figs, 4 refs)

50570 (MMIJ—8801, pp 397-398) **Problems on coal dust concentration measurement with explosion-proof dust meter.** Fusamura, Nobuo; Nagoya, Shunji; Tsuyoshi, Atsuhiro; Takeshita, Soichiro. (Waseda Univ., School of Science and Engineering, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Digital dust meters, or personal dust monitoring system (PDS), used in workshops to measure suspended dust cannot be used in coal mines because they are not explosion-proof. An explosion-proof dust meter (EDM) using near-infrared scattering was developed. The correlation between this EDM and a mass concentration meter was studied. A number of coal specimens were used. At one end of a chamber, a PDS, the EDM, a lowvolume sampler (C-30) with a multi-stage sizing screen, and other necessary components were placed. Dust was fed into the other end of the chamber. The meters and sampler were observed concurrently. The results of the observation have revealed that the coefficient of correlation between the EDM and C-30 is very high and that no correlation is found between the reflectivity and indicated relative concentration of each specimen. The performance of the EDM has been confirmed. However, in mine environment where much water is being used, generated much mist may affect measurements on the EDM. (5 figs, 1 tab)

50571 (MMIJ—8801, pp 524) **Electrification property of antistatic vinyl air pipe for prevention of charge by dust.** Sato, Eiichi; Seto, Masahiro; Sato, Suguru; Kono, Makoto. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

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Relative to the dust supply quantity and the velocity of ventilation, the antistatic property of a 100 m antistatic vinyl air pipe (hereafter called air pipe) was studied under coal dust feeding condition. Various experiments were also carried out to study the antistatic effect of grounding of the air pipe. It became clear that the air pipe reached the saturated charge voltage in about 120 seconds of the start of dust supply under the ventilation velocity of 5 m/sec or higher, and the entire pipe became at the same charge volt in an-

other 150 seconds. It became obvious that the charge volt was 0kV if grounding was made at 2 positions, indicating that the method had a good inhibition effect. As the result, it was learned that the interval of the grounding should be made to within 100 m for good inbibition effect, which can be improved more by bonding. It was also confirmed that the suspension of the air pipe by steel wire would have a similar effect. (2 figs, 2 tabs)

50572 **(OFR—888) Supervisory management selection and development.** Brown, G.R.; Temple, M.G.; Dreifke, W.L.; Knoeble, K.Y.; Murphy, D.E.; Gilfillan, D.P. (Bureau of Mines, Pittsburgh, PA (USA)). 1987. 183p. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

This report presents the results of a study examining the relationship between supervisor characteristics and performance in underground coal mines. The specific objectives of the research include: document tasks performed by first-line supervisors during a normal shift; explain why supervisors carry out their duties as they do; identify salient characteristics of effective first-line supervisors; and formulate criteria for selecting and developing candidate supervisors. To accomplish the study objectives, on-site observation and data collection was carried out at 13 underground mines in Illinois, Ohio, and Pennsylvania. One hundred thirty-eight first-line supervisors were observed during a full work-shift and discussions with the supervisors and the mine superintendent were held during the course of the visit. The observational data from the study provide a detailed description of what supervisors do during their shift. The report begins with an introduction discussing the problem being studied and objectives of the research. The literature related to supervisor selection is then reviewed. The following section describes the research design including data collection procedures and statistical methodology used in the study. The next sections present the analysis of mine, section, crew, and supervisor characteristics. The report concludes with a discussion of the results of the study and recommendations concerning supervisor selection and development.

50573 **(OFR—3288) Coal mine bump monitoring.** Descour, J.M.; Miller, J. (Bureau of Mines, Pittsburgh, PA (USA)). 1987. 111p. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

This report describes the monitoring of microseismic activity maintained during several major phases of retreat mining in the 9 Right section of Olga Portal #2 coal mine in Caretta, West Virginia. Significant observations were made regarding mining, stress indications, stability problems and microseismic event occurrence. The first part of the analysis of microseismic data was focused on recognition of parameters and mechanics of an individual microseismic source as an element of instability development. Results of this analysis should also be useful for the development of a real-time microseismic data acquisition and processing system. The second part of the analysis was oriented to determine the correlation between areal and temporal event distribution, mining situation, and geological parameters to improve the reliability of a bump forecasting technique. In particular, the microseismic data provided very descriptive and unique images of areal and temporal development of instability which resulted in a major multiple bump occurrence on June 3, 1985. Microseismic data and other observations suggest that a nonuniform horizontal stress distribution in the roof and floor is probably responsible for most of the bump and roof instability problems. Mining is the main cause of the stress concentration around mine openings. The instability distribution is influenced by the joint system. The configuration of gob contours with respect to the joint system also needs to be considered.

50574 **(OFR—3388) Design, fabrication, and testing of a hopper-feeder-bolter.** Giroux, D. (Bureau of Mines, Pittsburgh, PA (USA)). 1987. 69p. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

This report documents the design, fabrication, testing, and coal mine demonstration of a hopper-feeder-bolter during a four-phase program. The machine was designed to increase productivity and safety in underground room-and-pillar mining. It performed well as a hopper-feeder for continuous haulage during a coal mine demonstration. Testing in a simulated mine showed that the machine also has good roof bolting capability.

50575 **(PB—88-216064/XAB) Direct measurement and contouring of variable slip on single faults and fault arrays. Final report.** Watterson, J. (Liverpool Univ. (UK)). 15 Jul 1986. 35p. NTIS, PC E03/MF A01.

The primary objective of this study was to provide observational data on the variation in displacement on fault surfaces. The data base used was the plans and records of British coal fields. The purpose was to provide information that could be used to constrain models relating to the characteristics of a seismic source. Results include: (1) contour diagrams of displacement variation over several fault planes. These will be small faults with maximum dimensions of approximately one kilometer and maximum displacements up to 6 meters (m); (2) data showing maximum displacement gradients in the horizontal plane for displacements up to 10m; and (3) theoretical work on the elastic strain energy associated with the misfit between slipped and unslipped regions.

50576 **(RI—9172) Computer-assisted mine design procedures for longwall mining.** Kripakov, N.P.; Beckett, L.A.; Donato, D.A.; Durr, J.S. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 38p. Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

The Bureau of Mines has developed a unique new mine design procedure to determine the changing static load distributions imposed on underground support structures during the mining cycle. The procedure reduces the complexities associated with analyzing a three-dimensional problem. A combination of the multiple-seam displacement-discontinuity model and a two-dimensional finite-element window model produces refined results for a specific area of interest by assuming displacement compatability between models. Input to the procedure includes the geometry of mined-out areas in up to two adjacent seams, the rock mass characteristics of the surrounding geology, the in situ stress conditions, and the mining sequence. The displacement-discontinuity program calculates expected loadings for mine structures affected by the mining cycle and/or by overlying or underlying seams. Pseudoelastic finite-element analysis using a yield-factor approach determines the stability of coal pillars by simulating the degree and extent of progressive rib failure and subsequent load transfer. Application of the procedure is demonstrated on a field problem. Induced stress changes predicted from the numerical model analysis are in reasonably good agreement with stress measurements obtained from an instrumented chain pillar affected by remnant workings in an upper seam.

50577 **(RI—9177) Horizontal trajectories of rotary-drilled holes.** Goodman, T.W.; Cervik, J. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 11p. US Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

This Bureau of Mines report investigates the horizontal trajectory of boreholes drilled in coalbeds using the rotary drilling technique. Test holes drilled in coalbeds showed that the path of a borehole in the horizontal plane depends on drilling assembly configuration, drill bit rotation, and coalbed geologic features. An assembly that contained an 18-ft (5.5-m) long drill collar and two centralizers had the best horizontal stability evidenced by trajectories that deviated less than 16 ft. (4.9m) from a target at 1,000 ft (305m). Removal of one of the centralizers resulted in a loss of control of hole trajectory in the horizontal plane. Generally, holes tended to turn to the right, presumably because of right-hand rotation of the bit. Deviations from the original bearing line were as much as 200 ft (61 m) or more at a depth of 1,000 ft (305m).

0130 Transport And Handling

50578 **(DOE/PC/90957—T7) Fluidization mechanisms in slurry flows: Quarterly report.** Campbell, C.S. (University of Southern California, Los Angeles (USA). Dept. of Mechanical Engineering). Aug 1988. Contract FG22-86PC90957. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016833/JAW.

One purpose of this investigation has been to develop a transducer to measure the particle pressures independently from the

fluid pressure. At the beginning it was thought, erroneously, that the particle pressure was the only path by which the fluidization mechanism could be determined. The particle pressure transducer has been described in previous reports. Now, a sideline project has been to test these transducers and use them to measure the particle pressures generated against the side walls of gas-fluidized beds. This was begun as a way of gaining experience with the particle pressure transducer while awaiting the delivery of the pump and other components for the slurry pipe loop but has continued. Earlier this year, there was great difficulty in gaining repeatable results from the experiments. The culprit turned out to be static charge buildup in the granular mass. Hence, steam was injected into the air stream to help dissipate the charge buildup. This produced a further source of error that was eventually traced to the fiberoptic displacement transducer inside the probe. It turned out that the transducer was sensitive to humidity. The company, MTI, that manufactures it, has been at a loss to explain this phenomenon except to suggest that it might be a byproduct of the absorption of water onto the sensing surface which changes its optical properties and hence changes the output signal.

0140 Combustion

REFER ALSO TO CITATION(S) 50355, 50388, 50389, 51439, 51731, 51932, 52082

50579 **(CRIE-W—87009) Development of methods to predict NOx emissions in coal combustion and unburned carbon in fly ash.** Nakata, Toshihiko; Sato, Mikio; Makino, Hisao; Ninomiya, Toru. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1987. 33p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754540/JAW.

It is necessary to study the firing technique at a coal fired power generation plant to evaluate NOx emission and unburned carbon in fly ash from each coal corresponding to its properties. Main 28 coals were tested in a 100kg/h test furnace to predict NOx emission and unburned carbon from coal properties. The reduced size burners similar to those used in practical boilers were used. The conversion rate(CR) from N contents in coals to NOx could be precisely predicted by a linear equation of ratio x=FR/FN, where FR is fuel ratio expressed by fixed carbon/volatile matter, and FN is N content. That is, the equation is: $CR=a_1x+a_2$, where a_1 and a_2 are constants. A prediction equation can be applied also for the unburned carbon content. The equation is: $U=b_1FR+b_2$, where U is unburned carbon residual rate (residual rate of burnable components except ash in a coal) and b_1 and b_2 are constants. (26 figs, 5 tabs, 7 refs)

50580 **(CRIE-W—87021) Review on advanced coal fired thermal power plant technology (Part 1). Recent developments of low NOx combustion technology.** Ninomiya, Toru; Koyata, Kazuo; Sato, Mikio; Makino, Hisao. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1987. 75p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754545/JAW.

In order to achieve the advanced coal firing technology, firing technologies to reduce NOx emmision and residual unburned carbon in fly ash in coal fired thermal power plants using many kinds of coals in domestic and foreign countries, especially, developments for low NOx burners and low NOx burning system (in-furnace denitration process) were investigated. For the development of low NOx burner the method with which the firing area of volatile matter was made high temperature using lower air amount to form reducing atmosphere, was developed. For the development of low NOx firing system, the firing system in which NOx reduction and decomposition was effectively utilized after the boiler burning zone, was developed. The future issue is to develop the ultra low NOx burner and firing system to suppress NOx formed near a burner and reduce unburned carbon in fly ash. (68 figs, 17 tabs, 21refs)

50581 (DOE/METC—87/6082, pp 215-219) **Chemistry of the interaction of sodium and sulfur in flames.** Steinberg, M. (Univ. of California, Santa Barbara (USA)). Oct 1987. NTIS, PC A16/MF A01. Order Number DE87006516/JAW. Contract FG21-86MC23135.

In Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.

The primary objectives of the contract are the identification of the dominant reactions and the development of a general chemical kinetic model for the interaction chemistry of sodium and sulfur in flames. One motivation for the study is a better understanding of the chemistry that leads to sodium sulfate and corrosion in combustion driven gas turbines. Temperature, [Na], and [OH] profiles have been determines in 19 $H_2/O_2/N_2$ flames. Varying amounts of H_2S was added to 9 rich flames and SO_2 to 10 lean flames. Some [Na] and [OH] profiles for selected lean and rich flames are shown in figures to illustrate some general influences of temperature and composition.

50582 (DOE/METC—88/6084-Vol.1, pp 41-53) **Coal-water fuel combustion enhancement by means of high intensity sound.** Reethof, G. (Pennsylvania State Univ., University Park (USA)). Oct 1987. NTIS, PC A17/MF A01. Order Number DE88001002/JAW. (CONF-871041—Vol.1). Contract AC21-86MC23257.

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

The objectives of this contract are to theoretically and experimentally determine the feasibility of enhancing the combustion of coal-water fuels by means of high intensity sound at the proper frequency. The principal applications considered in this research are various types of heat engines such as gas turbines and piston engines. The attractiveness of these highly loaded coal-water mixtures is their pumpability, easy storability and non-flamability compared to oil, natural gas and finely pulverized coals. The coal-water fuels are injected into the combustors as finely dispersed mists by atomizing spray nozzles. In the research the authors expect to show that high intensity sound will substantially increase the convective heat transfer and mass transfer rates during the droplet evaporation phase, increase in coal particle heating rates to ignition and the oxygen diffusion rates to the burning char particles. Thus the burning process is expected to take place in a shorter time and at greater intensities resulting in shorter and more efficient combustors. The study has been divided into three tasks: development and testing of theoretical approach; design, development and testing of sonic water spray evaporator and other bench style experiments; and design and development of a new sonically enhanced small coal-water fuel research combustor. Each task is described and preliminary results are given.

50583 (DOE/METC—88/6084-Vol.1, pp 62-71) **Detailed model for practical pulverized coal furnaces and gasifiers.** Smith, P.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA)). Oct 1987. NTIS, PC A17/MF A01. Order Number DE88001002/JAW. (CONF-871041—Vol.1).

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

The principal objective of this study is to develop, evaluate and implement a practical, three-dimensional model for large-scale furnaces and gasifiers. Work conducted over the past decade at the laboratory has led to the development of a two-dimensional model for combustors and gasifiers, called PCGC-2 (Pulverized Coal Gasification or Combustion in 2-Dimensions). This work provides a strong foundation for development of the three dimensional (3-D) model. Many of the concepts and some of the components in PCGC-2 can be used directly in the 3-D code. Three principal tasks have been identified. Task 1 - Extend an available two-dimensional model to practical, three-dimensional, large-scale furnace and gasifier configurations. Task 2 - Evaluate the 3-D model through a statistical sensitivity analysis to determine model parameters most influential on furnace and gasifier predictions, and through review, selection, documentation and comparison of a set of available data relating to practical, large-scale (often 3-D) furnaces and gasifiers with model predictions. Task 3 - Improve or develop submodel equations and/or data for the comprehensive 3-D model. A submodel is a component part of the comprehensive model (e.g., radi-

ation, gas fluid mechanics, fouling/slagging). Results to date are discussed.

50584 (DOE/METC—88/6084-Vol.1, pp 110-121) **Heterogeneous kinetics of char combustion.** Gavalas, G.R.; Flagan, R.C. (California Institute of Technology, Pasadena (USA)). Oct 1987. NTIS, PC A17/MF A01. Order Number DE88001002/JAW. (CONF-871041—Vol.1).

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

Lignite and bituminous chars were derived from narrow size cuts of the parent coal. After pyrolysis in nitrogen, they were again sieved into narrow cuts and these were used for subsequent experiments. A low temperature reactor was constructed to measure char reactivities in the temperature range 700 K to 900 K. In addition, char reactivities for the bituminous coal were also obtained from a conventional thermogravimetric analyzer in this temperature range. Complete and extensive physical characterization of the chars at various stages of low temperature conversion was done using gas adsorption (surface area, pore volume distribution), mercury porosimetry, pyncnometry, and SEM data. Two flow-type gas adsorption apparatii were designed and fabricated to obtain BET surface areas (employing various adsorbate gases), pore size distributions and helium densities. This information along with the porosimetry data, was used to infer the intrinsic kinetics of the chars and to study the evolution of the pore morphology in the solid with varying carbon conversion. Evolution of surface area with conversion was experimentally determined. Particle temperature versus complete burn time traces for single burning char particles were obtained using two-color optical pyrometry. An electrodynamic balance was constructed to trap charged char particles, characterize them, and then measure reactivities by heating them with a CO_2 laser. Apart from experimental activities, extensive numerical modelling of single particle combustion has been done. The effects of char size, particle density, carbon emissivity, reaction rate, initial ash content and ash emissivity on particle temperature and burn time have been examined and are shown.

50585 (DOE/METC—88/6084-Vol.1, pp 122-137) **Kinetics of volatiles combustion.** Oct 1987. NTIS, PC A17/MF A01. Order Number DE88001002/JAW. (CONF-871041—Vol.1).

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

Engineering analyses of coal volatiles combustion, as well as the combustion of synthetic fuels and coal gasification or liquifaction products, can be accomplished through a mixing rule. Knowing the composition of the fuel mixture and the global kinetic rates of the main constituents in the mixture is sufficient for predicting combustion rates of such mixtures with the aid of such mixing rule. In the current investigation an assumption was made that the concept of a mixing rule is valid and data was reviewed to support or to repeal it. Current results indicate that a correct formulation of the rule is possible. Specifically, the following is a summary of the major results of the investigation. (1) A mixing rule for the combustion of hydrocarbon fuel mixtures has been formulated and tested with published data in the literature. Results indicate the possible use of such a rule for engineering calculations taking into account the fuel mixture composition. The mixing rule works in conjunction with a definition of concentrations as described in the text. The approach may be extended to coal volatiles once the composition of the volatiles is known. (2) A flat flame burner system has been developed for burning mixtures of gaseous and liquid fuels. Solid fuel with melting temperature lower than about 250°C (523 K) can also be utilized in the current system. Raman thermometry is used in conjunction with standard thermocouple techniques for flame temperature measurements. (3) Burning velocity data have been obtained for propane, toluene, xylene and several mixtures. Kinetic rates are derived from these data. 15 references, 18 figures, 6 tables.

50586 (DOE/METC—88/6084-Vol.1, pp 159-168) **Chemistry of the interaction of sodium and sulfur in flames.** Steinberg, M. Schofield, K. (Univ. of California, Santa Barbara (USA)). Oct 1987. NTIS, PC A17/MF A01. Order Number DE88001002/JAW. (CONF-871041—Vol.1).

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

The use of fuel/air systems containing sulfur and sodium in combustion driven gas turbines leads to turbine blade corrosion. Sodium sulfate, which either deposits on the turbine surfaces or is chemically formed there, has long been recognized as the source of the problem. To model the problem one must consider the sodium/sulfur chemistry in the hot gases approaching the turbine blades. The program objectives are the identification of the dominant reactions controlling sodium/sulfur chemistry, the development of a kinetic model for the system, and a more quantitative description of the sodium/sulfur species distribution in the hot gases in combustion driven gas turbines. This paper describes the experimental methods and discusses the results to date.

50587 (DOE/METC—88/6084-Vol.2, pp 686-697) **Radiant heating of one- and two-phase aerosols: slurry evaporation.** Sitarski, M.A. Oct 1987. NTIS, PC A18/MF A01. Order Number DE88001003/JAW. (CONF-871041—Vol.2).

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

The objective of this project is to develop a theoretical description of the radiant heating of individual one- and two-phase aerosol particles and using this description to examine the evaporation, explosive disruption, and ignition of coal-derived aerosol fuels and, subsequently, to theoretically describe the condensation of multicomponent vapors in an aerosol system. The paper discusses the absorption of an electromagnetic radiation inside a slurry droplet, heat transport inside an irradiated coal-water layered droplet, boundary conditions at the CWS droplet surface, and the Monte Carlo simulation of the heat transport inside a CWS droplet. It can be concluded from the results of the reported preliminary computations that the conditions for secondary atomization of the CWS droplets by disruptive boiling are the most favorable when: the slurry droplets are preheated to a boiling temperature; the gas surrounding the droplet during the initial time (of the order of 1 msec) is as much saturated with a water vapor as possible (for example: atomization by an application of the superheated steam), and has low (relatively to the radiating flame) temperature; and a non-volatile surfactant is present at the liquid-gas interface.

50588 **(DOE/PC/80511—T14) Hydrodynamics, mixing, and segregation in gas fluidized beds: Technical progress report, 22 April 1988-21 July 1988.** Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1988. Contract FG22-85PC80511. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015625/JAW.

The fluctuating motions of solid particles constitute a major feature of the gas fluidized beds. The global, large scale fluctuation of low frequency responsible for the observable oscillatory motions of the bed surface, and the local, small scale fluctuations of higher frequencies related directly with the bubble motion. Both fluctuations are likely to be induced by bubbles, but the mechanisms are different. The present analysis attempts to model the solids fluctuations below the bed surface due to direct bubble interactions by predicting fluctuations directly from bed parameters. A typical bubbling fluidized bed is illustrated in Fig. 4a. The bubbles are imagined to be arranged in a regular pattern as shown in Fig. 4b. For each bubble, there is an associated cubic box of dimension $(2a)^3$ with the bubble located at the center. The bubble diameter, bubble velocity and the box size are determined from existing theories. The Darton et als.' bubble diameter correlation was chosen since it was derived from a model of bubble coalescence. The box size can be determined from the two phase theory which assumes that the excess gas (i.e., gas flow in excess of the product of bed area and u/sub mf/) flows through the bed in the form of bubbles. In each box, the particle motion is assumed to be induced only by the bubble. As a first approximation, Davidson's bubble theory is used to evaluate the bubble induced particle motion. The basic equations for the particulate phase are comprised of a continuity equation and an Euler equation of motion. These equations are identical to the potential flow equations for an inviscid, incompressible fluid. Therefore, potential flow solutions can be adopted. Then, using the bubble centered cylindrical coordinate system at each fixed time, the absolute solids velocities, v/sub z/ and v/sub r/, in the laboratory frame can be determined. 7 refs.

50589 (EPRI-CS—5713, pp 6.1-6.26) **New opportunity to predict and verify effects of coal quality on the operation of heat exchangers through generic engineering.** Wagoner, C.L. (Univ. of Tennessee Space Institute, Tullahoma (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

Numerical engineering calculations are being developed for predicting slagging/fouling effects. The goal is to exceed limitations of presently used empirical indexes and evaluation techniques. Predictions can be inaccurate for the value of various levels of coal cleaning when based on correlations derived from experience with normal coals. Generic engineering has the potential to provide a new opportunity to predict and verify real-time effects of coal quality, including related costs, on the performance of heat exchangers at specific sites. This paper illustrates several initial applications of generic engineering, including prediction of deposition effects with upper furnace sorbent injection and cyclone furnace firing. Major problems are identified for applying results of laboratory analyses of ASTM coal ash. Sampling and analysis of particle-diameter fractions of materials entrained in combustion gases offer significant advantages over the use of traditional laboratory data. 14 references, 14 figures, 3 tables.

50590 (EPRI-CS—5713, pp 9.1-9.37) **Application of advanced coal testing techniques to improve boiler performance and predictions.** Lexa, G.F.; Miemiec, L.S.; Levasseur, A.A.; Mehta, A.K. (Combustion Engineering, Windsor, CT (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

The Electric Power Research Institute (EPRI) is sponsoring a comprehensive program to assess the merits of coal cleaning for utility boiler application. As part of this program, Combustion Engineering, Inc., (C-E) is investigating the combustion performance characteristics of cleaned coals and their commercial impacts. Raw and cleaned coals were evaluated during a series of bench-scale and pilot-scale combustion tests at C-E's Kreisinger Development Laboratory in Windsor, Connecticut. To date, the impact of cleaning on combustion and performance characteristics have been quantified for one lignite and three bituminous coals. Test results on the raw (baseline) and cleaned coals indicate improvements in pulverization, convection pass fouling and fly ash erosion characteristics due to cleaning. The application of results from this study show significant reductions in utility steam plant operating and maintenance costs when using higher quality coals. Although these results are specific to the coals and study units evaluated, they clearly illustrate the potential for electric generating cost reduction through physical coal cleaning.

50591 (EPRI-CS—5936-SR) **Effect of coal quality on power plants: Proceedings.** Mehta, A. (ed.); Dooley, R.B. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA)). Sep 1988. 697p. (CONF-871050—). Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016609/JAW.

From Effects of coal quality on power plants; Atlanta, GA, USA (13 Oct 1987).

A conference on Effects of Coal Quality on Power Plants was held on October 13--15, 1987 at the Ritz-Carlton Hotel in Atlanta, Georgia. The conference was sponsored by The Electric Power Research Institute (EPRI) and hosted by the Georgia Power Company and Southern Company Services. Approximately 150 people participated in the conference. They represented domestic and foreign utilities, equipment vendors, research organizations, contractors and consultants. The objective of the conference was to review document and transfer technology on various aspects of coal quality and its effects on power plants. To meet these objectives, presentations and discussions were organized on the following topics: Coal Quality Problems---Slagging/Fouling; Coal Quality Problems---Abrasion/Erosion/Corrosion; Fundamental Research on Mineral Matter Transformation; Pilot Scale Combustion Testing; Coal Quality Impact Evaluations; and Utility Experience. Each topic was presented through a number of relevant papers and discussed in a separate conference session. Four working groups were organized on the second day of the conference for the attendees to discuss their problems, concerns and experiences and to recommend areas needing further research and development.

50592 (FSJ—8601, pp 152-155) **Effects of minerals in coal upon the properties of coal water mixture.** Ando, Takashi; Oka, Naoki; Yamada, Takeo. (Idemitsu Kosan Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

Coal-water mixture (CWM) is a fuel provided with a function as the fluid, which is composed of pulverized coal, water and a surface-active agent. Deashed coal manufactured by removing the minerals from the coal is preferable for the feed coal of CMW. The evaluation of the slurry of various ranks of deashed coal and the effect of the minerals contained in the coal on the properties of slurry were investigated. The existence of montmorillonite was indentified as a mineral component in the coal by the X-ray diffractometry. The effect of it on the concentration of slurry was clarified. The concentration of slurry depends upon the content of montmorillonite as well as the coal rank of feed coal. Montmorillanite plays an important role in the still-standing stability of CWM. It was found that montmorillonite has antipodal features, the negative effect to decrease the concentration of slurry and the positive effect to improve the still-standing stability. (5 figs, 2 tabs, 4 refs)

50593 (FSJ—8601, pp 156-159) **Study of various factors relating to the stability of CWS.** Doi, Shinji; Shibata, Junji; Oda, Hirokazu; Yokokawa, Chikao; Hashi, Kazuo. (Kansai Univ. Faculty of Engineering, Osaka, Japan; Kubota, Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

As various factors relating to the stability of coal-water slurry (CWS), the effects of characteristics of coal; such as componental features, density, and the amount of functional group containing oxygen; on the amounts of saturation absorption of water, the surface coverages of surfactants, and the zeta electric potentials of coal particles were investigated. The amount of steam absorption was closely related to the specific surface of coal; the larger was the specific surface of coal, the greater was the amount of steam absorption on it. The zeta electric potential was adopted as a parameter showing the electrochemical characteristics of coal surface. After the addition of surfactants, coal surfaces were negatively charged owing to the absorption of the surfactants, and showed the zeta potential, -50 - -60mV, over the wide pH range, from acidic to basic. In addition, the coal containing much inert components was found to have the property for dispersional stabilization.

50594 (IFRF-F—037/a/16) **NOx reduction with coal firing by application of both internal air staging and fuel rich precombustors. Report on the AP 14 trials.** Weber, R.; Smart, J.P.; Phelan, W.J. (International Flame Research Foundation, Ijmuiden (Netherlands)). Feb 1987. 84p. International Flame Research Foundation, P.O. Box 10000, 1970 CA IJmuiden, Netherlands.

The overall objective of the AP 14 trial was to investigate several burner designs and to assess each burner type for both potential NO/sub x/ reduction capability and carbon conversion efficiency. Two of the burner designs were based on the internal air staged concept whilst the third was equipped with a precombustor. Proximate and ultimate analysis of the two coals used in the test programme, namely Scotts Branch and Heinrich Robert, are shown. Standard IFRF techniques were used for the measurement of gas concentrations, temperatures and solids. When high volatile bituminous coal Scotts Branch was fired in internally air staged burner No. 1, short low NO/sub x/ flames (320 ppm; 0% O/sub 2/) with relatively good char burnout (96-97.5%) were obtained. This concept looks attractive for industrial application. Burner No. 2

concept was unsuccessful. For Scotts Branch coal as well as Heinrich Robert coal, flames of very good char burnout (> 98%) but rather high NO/sub x/ level in the flue (> 700 ppm; 0% O/sub 2/) were observed. Burner No. 3 equipped with a short precombustor and a standard gun gave only marginal control of NO/sub x/: 420-700 ppm for Scotts Branch and 260-420 ppm for Heinrich Roberts. The precombustor burner concept looked attractive for industrial applications provided that residence time in the fuel rich zone is long enough. 33 figs., 9 refs., 13 tabs.

50595 (IFRF-F—138/a/6) Calcination and sulphation studies under controlled conditions for direct application to desulphurisation of pulverised coal flames. Report on the S 2 experiments, parts 1 and 2. Flament, P.; Bortz, S.; Weber, R. (International Flame Research Foundation, Ijmuiden (Netherlands)). Feb 1987. 76p. International Flame Research Foundation, P.O. Box 10000, 1970 CA IJmuiden, Netherlands.

At the beginning of the present decade, interest developed in the possibility of sulfur dioxide emission control on pulverized coal fired boilers through the retrofitting of calcium based sorbent injection facilities. The object was to inject powdered sorbents into the combustion chamber, preferably with coal. The development of the research equipment and the initial sorbent calcination studies (part 1) and the subsequent sulfation studies (part 2) are reported. An isothermal plug flow reactor was developed for this research program. Two baseline sorbents with similar particle size distributions, were used during the experiments: hydrated lime (Ca(OH)/sub 2/) and limestone (CaCO/sub 3/). In general, as found in the semi-industrial scale tests, hydrated limes gave results which were significantly superior to those given by the limestones. From the point of view of gaining a more detailed understanding of the process, the results gained with the baseline limestone were subjected to a more detailed analysis. It was shown that at low temperatures, the calcination process as well as the sulfation process are kinetically controlled but around 900 C the process changes. Additional study is required to find an explanation for this. The experiments clearly demonstrated that neither the rate nor the final degree of sulfation were correlated with the initial BET-area. It was concluded that the pre-calcination of raw sorbents do not improve significantly the sulfur capture. 31 figs., 12 refs., 31 tabs.

50596 (IFRF-F—336/a/9) Computations of isothermal swirling vortices in the near burner zone. Report on the MMF 1-1 investigation. Visser, M.; Boysan, F.; Weber, R. (International Flame Research Foundation, Ijmuiden (Netherlands)). Jun 1987. 179p. International Flame Research Foundation, P.O. Box 10000, 1970 CA IJmuiden, Netherlands.

The overall objective of this research program (MMF) is to assess the potential of mathematical modelling for the prediction of pulverized coal flames (MMF 1) and if reasonable results are obtained to apply the tool for scaling of the burner design series (AP) experimental results. The evaluation process has been split up into two phases. This report deals with the first phase (MMF 1-1): testing of the model against the IFRF measurements of expansions of isothermal swirling vortices. Fifteen cases of expanding swirling flows were computed using several turbulence model variations implemented using the computer code Fluent. The computed cases differed in quarl/furnace geometrics, type of initial swirling vortex, initial swirl number, etc. Conclusions were made relevant to the predictions of mean flow pattern, the flow model and the quality of the predictions. 2 app., 40 figs., 29 refs., 4 tabs.

50597 (IFRF-G—13/a/3) A review of fuel staging in pulverised coal combustion systems. Knill, K.J. (International Flame Research Foundation, Ijmuiden (Netherlands)). Sep 1987. 54p. International Flame Research Foundation, P.O. Box 10000, 1970 CA IJmuiden, Netherlands.

Existing mechanistic and process research results concerning the reburning process are summarized and important process variables related to reburning effectiveness are identified. The potential for fuel staging to reduce NO emissions in retrofit applications is considered and problems are identified. Fuel staging has been demonstrated at full scale as a suitable method for NO reduction. In utility boilers, fuel staging has been used to reduce NO by 50% to 85-200 ppm at 0% O/sub 2/. However, operational difficulties may have limited its application in new furnace designs, to date. The mechanism for NO reduction by fuel staging has been studied using gas flames. Hydrocarbon radicals must be generated to react with NO producing HCN. The HCN must be oxidized to NCO and then reduced to N/sub 2/ through a series of intermediate reactions. Several operating parameters that influence the effectiveness of fuel staging to reduce NO emissions are stated. Fuel staging has not been applied effectively in retrofit applications. This may be due to difficulties in obtaining sufficient carbon burnout as a result of decreased firing density in the primary combustion zone. Also, an optimum process configuration to minimize NO emissions has not been determined. This may be due, in part, to limited and contradictory conclusions from laboratory investigations. 24 figs., 34 refs., 1 tab.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 50353, 50356, 50484, 51398, 51416

50598 (EPRI-CS—5713, pp 15.1-15.7) Buying coals from the spot market. Potter, R.F. (Technical Services for Electric Fuels Corp., St. Petersburg, FL (USA)). May 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010316/JAW. (CONF-8611249—).

From Reducing electricity generation costs by improving coal quality; Indiana, PA, USA (5 Nov 1986).

One of the simplest philosophies used by the Electric Fuels Corporation, Florida is to consider as many available coals, both foreign and domestic, as possible for delivery to the plants. They feel quite willing to investigate and test promising coals in order to provide the plants with the compatible, consistent fuels they need. The key element is that the fuel offers an economic advantage in terms of the cost of electricity and can be worked into the compatibility ranges required. Clearly, the world markets do offer some interesting prospects. EFC currently has taken shipments from Columbia and Canada in addition to new domestic sources, most recently Alabama coals. Operation of diversified delivery systems is a positive advantage to EFC and Florida Power Corporation in that there is a degree of competition between river, rail, truck, and ocean delivery modes. This also gives them a supply of coal in the event of strikes, or potential natural disasters. Purchasing of spot coals has been an effective way to introduce some additional quality coals to Crystal River's plants and decrease overall costs. The benefits of spot coals and other high-quality fuels at Florida Power's Crystal River plants are quite apparent. Units 4 and 5 at Crystal River each currently produce approximately 100 MW over their initial design ratings. This was accomplished at efficiencies in the range of 0.5% better than design. In addition, these units both placed in the nation's top ten most efficient units. Collectively, Units 1, 2, 4, and 5 produce the cheapest coal-generated cost per megawatt electricity among the major utilities in Florida.

50599 (IEE—8702) Export potential of Chinese coal. Kimura, Toru. (Institute of Energy Economics, Tokyo (Japan)). 25 Jun 1987. 33p. (In Japanese). Inst. of Energy Economics, 1-18-1, Toranomon, Minato-ku, Tokyo.

As of end of 1985, Chinese coal reserve is 769 billion tons, out of which 43% is located in the North-Western part of the country. 67% of the total coal are of less than 1% sulfur content. Quantity of export is less than 1% of the total production. Its export amount is annually 350 million dollars which is only 1.5% of the total export of the country. But its rate of increase of annual sales is 20% and will keep the level of 10% even in the nineties. Out of the three types of coal in the world, raw material coal, general purpose coal, and anthracite, the general-purpose coal will grow more than others. China has built 5 large coal washing plants by introducing advanced coal washing units from West Germany, USA, etc.. Its coal quality is behind the international level and is stable. Its dirt is also a big problem. Fundamental problem of the Chinese coal is the production control rather than the coal itself. However, the quality of export grade will be guaranteed because various measures are being taken. (4 figs, 16 tabs)

0160 Health And Safety

REFER ALSO TO CITATION(S) 50537, 50566, 52442

50600 (CONF-760202—, pp 748-754) Facility certification program for coal miners pneumoconiosis. Trout, E.D.; Kelley, J.P.; Larson, V.L.; Herbert, G.L. (Oregon State Univ., Corvallis (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Public Law 91-173, often referred to as the Black Lung Law, called for a chest radiograph of all active coal miners at stated intervals. The National Institute for Occupational Safety and Health was responsible for carrying out the provisions of the law. Among other requirements was a provision for certification of radiological facilities where radiological examinations would be provide. A test object to be radiographed by each such facility was designed and sent to those facilities applying for certification. To date, 284 facilities have applied for certification of which 215 have been approved. A record has been kept of the number of times any approved facility submitted radiographs before approval. A complete listing of the types of equipment used, personnel qualifications and other pertinent data will be reported.

50601 (OFR—2088) Personal equipment for low seam coal miners: Development and testing of knit fabric gloves. Sanders, M.S.; Krohn, G.S.; Downing, J.V.; Shaw, B.E. (Bureau of Mines, Pittsburgh, PA (USA)). 1985. 60p. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

This report discusses the development and testing of prototype gloves for underground mining work. An analysis of HSAC hand-finger injuries revealed three high-risk jobs: laborer, mechanic, and roof bolter. Laboratory tests of dexterity and protection were performed using six off-the-shelf gloves. Two prototype gloves were developed. Both were Kevlar-cotton blend knit gloves. One had polyvinyl "Ks" screened on the palm and fingers, and a hand pad sewn into the palm. The other prototype had the palm and fingers coated with a solid layer of polyvinyl and had no hand pad. Field tests revealed that the solid-coated gloves were preferred by workers, but that the polyvinyl melted when working with hot drill steels.

50602 (OFR—2188) Personal equipment for low seam coal miners: Improved knee pads, a modified design. Sanders, M.S.; Shaw, B.E. (Bureau of Mines, Pittsburgh, PA (USA)). 1986. 23p. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

This report describes the development and field test to improve knee protection for underground coal miners working in low seam mines. In a previous phase of this contract (Sanders, 1982), experimental knee pads were developed and field tested. The field test revealed several design deficiencies with the knee pads, and suggestions for improving the design were made. The work summarized in this report, therefore, consists of modifying the design and method of fabrication of the knee pads originally described by Sanders (1982), and of field testing the improved design. The new prototype was shorter and wider than the original design, and used a neoprene pass-through strap design rather than a cloth strap molded into the pad itself. The new prototype was constructed by slush molding a hollow bladder that was then filled with foam. Initial reactions to the pads in the field test were very positive. However, after 2 months, the opinions about the new prototype became less positive. They were judged, generally, to be no better or worse than the pads usually worn by the field-test participants. Problems were encountered in the field with respect to durability. Water seeped into the inner cavity of many of the pads and caused the foam to deteriorate. It was concluded that it would not be cost-effective or feasible to significantly improve upon current commercially available knee pad designs.

50603 (PB—88-221478/XAB) Utilisation of accident data to improve safety in the human-factors aspects of system design. Final report. Graveling, R.A.; Mason, S.; Rushworth, A.M.; Simpson, G.C.; Sims, M.T. (Institute of Occupational Medicine, Edinburgh (UK)). Dec 1987. 83p. (TM—87/16). NTIS, PC E06/MF E06.

It is not feasible to use the existing British Coal accident information collection, storage and retrieval system to identify systematically human factors issues relevant to the accident. The implementation of a human factors code list, developed during the project, could provide the means whereby such information could be obtained and could provide the basis for identifying priorities for accident programs concentrating on human factors. The current accident-reporting system was developed to fulfill statutory obligations rather than to provide an avenue for identifying underlying causative factors. Nevertheless, only relatively minor changes would be required to provide the valuable information. The project has therefore shown that an accident-reporting system, sensitive to human-factors issues in accident etiology is feasible and has provided the basis on which such a system could be developed for assessment.

50604 (PB—88-221866/XAB) Variability of exposure of coal miners to inspirable dust. Final report, February 1983-January 1987. Mark, D.; Cowie, H.; Vincent, J.H.; Gibson, H.; Lynch, G. (Institute of Occupational Medicine, Edinburgh (UK)). Jan 1988. 166p. (TM—88/02). NTIS, PC E08/MF E08.

The aim of the project was to provide information about the variability of exposure of coal miners to fractions of airborne dust-containing particles that are coarser than those contained within the respirable subfraction. An available static inspirable dust (ID, particles that may enter through the nose or mouth during breathing) sampler and a newly developed personal sampler were used in underground trials. For the majority of occupational groups studied, it is possible to use a static respirable dust (RD) sampler to estimate personal ID exposures. In general, linear relationships were found between a mineworker's exposure to a given subfraction and his exposure to ID. The results support earlier conclusions that estimates of exposure to coarse fractions correlate no better with symptoms of upper airways disease than RD exposure estimates.

02 PETROLEUM

REFER ALSO TO CITATION(S) 50705

50605 (JNOC—8601) Annual reports of petroleum development technology center (FY 1985). (Japan National Oil Corp., Tokyo). 30 Jun 1985. 133p. (In Japanese). NTIS (US Sales Only), PC A07. Order Number DE88752065/JAW.

Research activities of the Technical Center is briefly described: objectives, procedure, content, and results, and the problems involved. Continuing topics are: evaluation/analysis technology of geological/geophysical exploration data, comprehensive system of analysis. High accuracy seismic exploration. Carbon dioxide miscible process. Secondary and tertiary recovery technology. Oil layer simulation. Artificial oil production. New research themes for 1985 are: High accuracy oil layer evaluation; exploration of small scale ocean oil field; research of production technology under high temperature and corrosive environment; and basic geological survey of Antarctic area. (99 figs, 16 tabs)

0201 Reserves

50606 (GS—8726) Conventional oil resources of western Canada (light and medium). Podruski, J.A.; Barclay, J.E.; Hamblin, A.P.; Lee, P.J.; Osadetz, K.G.; Procter, R.M.; Taylor, G.C.; Conn, R.F.; Christie, J.A. (Geological Survey of Canada, Ottawa, Ontario). 1988. Vp. (MICROLOG—88-03320). Geological Survey of Canada, Publications Distribution, 601 Booth St., Ottawa, Ont., Canada K1A 0E8; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An examination of 78 established petroleum exploration plays and 49 conceptual plays of the Western Canada Sedimentary Basin formed the basis for new estimates of the established plays, in which about 2,360 x 10/sup 6/ m/sup 3/ of recoverable oil have already been discovered, have an additional 509 x 10/sup 6/ m/sup 3/ (median value) of recoverable oil still to be discovered. An additional 61 x 10/sup 6/ m/sup 3/ (median value) are estimated to occur in conceptual plays that have not yet been successfully tested. The remaining potential is predicted to be dispersed in more than 4,000 separate accumulations, most of which would be small relative to existing discoveries. These estimates were prepared without any economic constraints; Part 2 of this report attempts to identify the proportion of the potential that might be economically exploitable. Estimates are presented of the long-term relationship between oil prices and western Candian light-medium oil potential. The economic analysis deals only with long-term profitability at the time an exploratory drilling decision is made. The study shows that 70% of the undiscovered light and medium oil resources may be profitable over the long-term at prices ranging from $CAN 94 to 142/m/sup 3/ ($CAN 15 to 22.50 bbl). The relationship of price and economic potential is relatively inelastic in this price range. 143 refs., 118 figs., 81 tabs.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 50490

50607 **(PRI—8308) Bibliography of geological and engineering studies of the Cardium Formation and its hydrocarbon reservoirs.** Krause, F.F.; Collins, H.N.; French, R. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Aug 1983. 36p. (CE—01826). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This is a comprehensive bibliography of geological and engineering studies of the Cardium Formation in Alberta and its hydrocarbon reservoirs. Included are 303 references from 1954 to the present. This work enables the convenient access to a large variety of sources of information that can be related to a particular Cardium reservoir. The majority of references pertain to the Pembina Field, demonstrating simply the importance of this particular reservoir. Individual listings identify specific reservoirs and whether or not the reference in question is available through the Petroleum Recovery Institute. Reservoir references identified as general are not directly related to a particular Cardium reservoir but rather to the Cardium Formation as a whole. 303 refs.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 50650, 50655

50608 **(AEDT—87) Alberta oil and gas equipment manufacturers and exporters index, 1987.** (Alberta Economic Development and Trade, Edmonton (Canada)). 1987. 192p. (MICROLOG—88-03729). Alberta. Dept. of Economic Development and Trade, Sterling Place Bldg., 9940-106 St., Edmonton, Alta., Canada T4K 2P6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This index provides an overview of the products produced in Alberta by leading manufacturers of gas and oil field equipment. It presents the names of specific oil and gas field products arranged alphabetically. Within each product category, the respective manufacturers are listed alphabetically. This information is preceded by a company name index.

50609 **(AEEW-R—2232) Adsorption of chromium chloride onto Clashach sandstone from solution.** Hubbard, S.; Johnson, P.A.V. (UKAEA Atomic Energy Establishment, Winfrith). Feb 1988. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754001/JAW.

This report deals with some studies of chromium (III) transport through Clashach sandstone in the absence of polymer. It was shown that chromium adsorbs onto rock both reversibly and irreversibly. The use of gamma labelled chromium showed that adsorption was not uniform, even over short distances within a core, nor could it be related simply to porosity. It was concluded that, as chromium interacts with the rock surface, a delayed breakthrough of chromium in a gel flood does not necessarily indicate that gelation has occurred.

50610 **(DOE/FE/61445—T1-Exec.Summ.) Reservoir analysis study, Naval Petroleum Reserve No. 1, Elk Hills Field, Kern County, California: Phase 2 report, Executive summary.** (Bergeson (Jerry R.) and Associates, Inc., Golden, CO (USA)). Jul 1988. Contract AC01-88FE61445. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88013975/JAW.

The Naval Petroleum Reserve No. 1 (Elk Hills) is located in Kern County, California, and is jointly owned by the US Department of Energy and Chevron USA Inc. The Elk Hills Field is presently producing oil and gas from five geologic zones. These zones contain a number of separate and geologically complex reservoirs. Considerable field development and production of oil and gas have occurred since initial estimates of reserves were made. Total cumulative field production through December 1987 is 850 MMBbls of oil, 1.2 Tcf of gas and 648.2 MMBbls of water. In December 1987, field producing rates expressed on a calendar day basis amounted to 110,364 BOPD, 350,946 Mcfd and 230,179 BWPD from 1157 producers. In addition, a total of two reservoirs have gas injection in progress and four reservoirs have water injection in progress and four reservoirs have water injection in progress. Cumulative gas and water injection amounted to 586 Bcf of gas and 330 MMB of water. December 1987 gas and water injection rates amounted to 174 MMcfd and 234 MBWPD, into 129 injectors. In addition, a steamflood pilot program is currently active in the Eastern Shallow Oil Zone. Jerry R. Bergeson and Associates, Inc. (Bergeson) has completed Phase II of the Reservoir Analysis, Naval Petroleum Reserve Number 1, Elk Hills Oilfield, California. The objectives for this phase of the study included the establishment of revised estimates of the original oil and gas-in-place for each of the zones/reservoirs, estimation of the remaining proved developed, proved undeveloped, probable and possible reserves, and assessment of the effects of historical development and production operations and practices on recoverable reserves. 28 figs., 37 tabs.

50611 **(DOE/FE/61445—T1-Vol.1) Reservoir analysis study, Naval Petroleum Reserve No. 1, Elk Hills Field, Kern County, California: Phase 2 report, Volume 1.** (Bergeson (Jerry R.) and Associates, Inc., Golden, CO (USA)). Jun 1988. Contract AC01-88FE61445. 624p. NTIS, PC A99. Order Number DE88013977/JAW.

Jerry R. Bergeso and Associates, Inc. (Bergeson) has completed Phase II of the Reservoir Analysis, Naval Petroleum Reserve Number 1, Elk Hills Oilfield, California. The objectives for this phase of the study included the establishment of revised estimates of the original oil and gas-in-place for each of the zones/reservoirs, estimation of the remaining proved developed, proved undeveloped, probable and possible reserves, and assessment of the effects of historical development and production operations and practices on recoverable reserves. Volume one contains the following: summary; introduction; and reservoir studies for tulare, dry gas zone, eastern shallow oil zone, western shallow oil zone, and Stevens --MBB/W31S, 31S NA/D.

50612 **(DOE/FE/61445—T1-Vol.1-App.) Reservoir analysis study, Naval Petroleum Reserve No. 1, Elk Hills Field, Kern County, California: Phase 2 report: Volume 1, Appendices.** (Bergeson (Jerry R.) and Associates, Inc., Golden, CO (USA)). Jun 1988. Contract AC01-88FE61445. 409p. NTIS, PC A18; 3; GPO Dep. Order Number DE88013978/JAW.

The objectives for the Phase II study included the establishment of revised estimates of the original oil and gas-in-place for each of the zones/reservoirs, estimation of the remaining proved developed, proved undeveloped, probable and possible reserves, and assessment of the effects of historical development and production operations and practices on recoverable reserves. 43 figs., 103 tabs.

50613 (DOE/FE/61445—T1-Vol.2) Reservoir analysis study, Naval Petroleum Reserve No. 1, Elk Hills Field, Kern County, California: Phase 2 report: Volume 2. (Bergeson (Jerry R.) and Associates, Inc., Golden, CO (USA)). Jun 1988. Contract AC01-88FE61445. 400p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88014017/JAW.

The objectives for this Phase II study included the establishment of revised estimates of the original oil and gas-in-place for each of the zones/reservoirs, estimation of the remaining proved developed, proved undeveloped, probable and possible reserves, and assessment of the effects of historical development and production operations and practices on recoverable reserves. Volume two contains reservoir studies for: Stevens{endash}26R/2B; Stevens{endash}29R242/132/Asphalto; Stevens{endash}Northwest; and Carneros.

50614 (DOE/MC/21207—6) New concepts for improving oil recovery in carbon dioxide flooding: Final report, September 4, 1984-March 4, 1987. Whitman, D.L.; Terry, R.E.; Ewing, R.E. (Wyoming Univ., Laramie (USA). Enhanced Oil Recovery Inst.). Apr 1988. Contract AC21-84MC21207. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001226/JAW.

The conclusions that can be drawn from the 3-dimensional physical simulator system are as follows: 1. The 3-D laboratory simulator is capable of evaluating the effect of different injection and production schemes. This work compared the use of vertical and horizonal injection wells in miscible carbon dioxide flooding. Other combinations of injection/production schemes could be studied as well. 2. A relative increase in oil production of approximately 24% is seen when utilizing the horizontal well for carbon dioxide injection as compared to a vertical injection well. 3. An approximate economic analysis indicates that the additional oil recovery generated can more than offset the cost of the horizontal lateral drilling. 4. The horizontal injector resulted in lower instantaneous gas-oil ratios when compared to the vertical injection well. This is most likely due to the more efficient contact between carbon dioxide and the oil that is created by the horizontal well. 5. For the laboratory simulator, the investigators saw no real effect of carbon dioxide injection rate (or velocity) on the recovery results. The follow conclusions can be drawn from the polymerization project: 1) An apparatus was constructed that permits in situ generation of polymers in supercritical carbon dioxide and also allows the measurement of the viscosity of any resultant carbon dioxide/polymer system. 2) Light olefins may be readily polymerized in an environment of supercritical carbon dioxide using commonly available initiators. 3) While polymers have been made, no apparent viscosity increases have been measured. 38 refs.

50615 (DOE/MC/22042—10) Reservoir characterization for the CO_2 enhanced oil recovery process: FY 1987 annual report. Orr, F.M. Jr.; Grader, A.S. (Stanford Univ., CA (USA). Dept. of Petroleum Engineering). Apr 1988. Contract AC21-85MC22042. 268p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001227/JAW.

This report summarizes progress in a research effort to quantify the effects of nonuniform flow on displacement performance in CO_2 floods. Results are reported in three areas: (1) effect of phase behavior in one-dimensional flow; (2) interaction of viscous instability and flow in heterogeneous porous media; and (3) detection and representation of heterogeneity. In the first area, the development of a new experimental apparatus for simultaneous measurement of phase compositions, viscosities, and densities is described. In the second area, partly-scaled experiments to study the effects of viscous instability in the presence of permeability variation are described. In addition, results of detailed simulations of the growth of viscous fingers in both homogeneous and heterogeneous porous media are described. In the third area, use of a combination of pressure transient and well-to-well tracer tests to detect the presence of reservoir heterogeneities is discussed. Also presented is a technique for calculation of the transient pressure response to large scale heterogeneities and an analysis of the pressure response of one- and two-dimensional composite reservoirs. Finally, results of calculations of the effects heterogeneity and capillary and viscous crossflow are reported. 170 refs., 139 figs., 11 tabs.

50616 (ERCB/C—D88-11) Cimarron Petroleum Ltd., ICG Resources Ltd. Application for well licenses. Decision D88-11. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 6 Jul 1988. 17p. (CE—01836). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

Hearings were conducted in the matter of licenses to drill hydrocarbon wells near Calgary, Alberta. The issues considered with respect to the license applications were the purpose and need for the wells, the proposed surface and bottom-hole locations, the drilling of the wells, emergency response plans, production from the wells, and the environmental impacts of the wells. Since data from nearby wells indicate that significant hydrogen sulfide content could be expected from these new wells, a major concern was the possible impact of sour gas emissions; and, due to their proximity to the Calgary city limits, concern was expressed over limiting the term of production to allow for future urban development. In view of these concerns, the applicants had proposed very comprehensive and conservative drilling, safety, and emergency response plans. The applications were approved subject to certain conditions. These included the requirement for an intermediate well casing, refusal to permit drilling by more than one well in the critical zone at the same time, no drill-stem testing, and revision of emergency response plans to require well ignition of hydrogen sulfide levels reach 1 ppM for a 1-hour period at the nearby city limits. 1 fig.

50617 (ERCB/C—IL88-11) Shop servicing and testing of blowout preventers and flexible bleed-off and kill-line hoses. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 7 Jul 1988. 5p. (CE—01838). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

This document outlines the requirements currently in effect in Alberta for the three-year shop servicing and testing of blowout preventers and flexible bleed-off and kill-line hoses. Such testing is required to be done at their working pressure; test data and maintenance performed is to be recorded and made available on request. Procedures include disassembly, inspection, repair, pressure tests, and documentation. Sample test report forms are included.

50618 (NIPER—298) Laboratory measurements of electrical resistivity at reservoir conditions: Topical report. Mahmood, S.M.; Maerefat, N.L.; Chang, M.M. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Apr 1988. Contract FC22-83FE60149. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001230/JAW.

The influence of laboratory procedures and test conditions, such as confining pressure and temperature on the electrical properties of rocks, was investigated. Results of electrical resistivity measurements on samples of Berea sandstone cores, Shannon subsurface and outcrop cores, and synthetic and carbonate cores are presented. During the experiments, temperatures (minimum 75{degree} F; maximum 200{degree} F) and confining pressures (minimum 500 psi, maximum 6,000 psi) were varied. The brine saturation ranged from irreducible water to 100 percent saturation. The fluids used in most of the experiments were Soltrol-220 and brine (2, 5, and 10 percent NaCl). The results show that the electrical resistivity measurements varied with temperature and confining pressure for almost all of the cores tested. The effect of temperature and confining pressure on electrical resistivity measurements indicates that cementation factor and saturation exponent measured at laboratory conditions are not the same as those measured at reservoir conditions. This effect was observed even after correcting for changes in porosity and saturation due to pressure and temperature variations. The experimental work has shown the difficulties involved with electrical resistivity measurements of carbonate rocks at reservoir conditions. The experiments are tedious, time-consuming and prone to errors. Some major problems are the presence of residual air due to low permeabilities, fluid/rock interaction with some brines, breaking of the core along the fracture lines, and poor contact with the electrodes. Further experimental work in this direction is recommended. 21 refs., 2 tabs., 21 figs.

50619 (NIPER—365) [National Institute for Petroleum and Energy Research] Quarterly technical report for April 1-June 30, 1988. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 2 Sep 1988. Contract FC22-83FE60149, 173p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88016486/JAW.

The Quarterly Technical Report, NIPER-365, covers the period April 1 to June 30, 1988, and reports on the research program outlined in the "FY87 Annual Research Plan." It is submitted in accordance with the provisions of Cooperative Agreement DE-FC22-83FE60149 between the Department of Energy and IIT Research Institute. This report covers energy production research and fuels research.

50620 (PRI—1983-3) A review of laboratory techniques for measuring wettability of petroleum reservoir rocks. Ionescu, E.; Maini, B.B. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Oct 1983. 33p. (CE—01822). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents a review of laboratory techniques for measuring wettability of petroleum reservoir rocks. The advantages and disadvantages of each technique are discussed. The review indicates that precise, quantitative measurement of wettability remains a difficult task. While no single technique is applicable in all situations, Amott's method employing spontaneous imbibition and forced displacement tests appears to be a suitable starting point for evaluation of wettability of a given reservoir. Evaluation of capillary and effects in displacement tests, especially with in-situ saturation measurement techniques, appears to be a promising alternative. 42 refs., 6 figs.

50621 (PRI—1984-4) Miscible displacement of residual oil-effect of wettability on dispersion in porous media. Ionescu, E.; Batycky, J.P.; Maini, B.B. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Oct 1984. 38p. (CE—01821). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In miscible displacement of residual oil, the dispersion of injected fluid is an important consideration in determing the optimum slug size. The extent of dispersion depends, in addition to the flow rate and characteristics of the porous medium, on the wettability of the fluid-rock system. This work presents experimental evaluation of the effect of wettability on dispersion. Three types of miscible displacement were performed in cores of differing wettability: displacement of water or oil at 100% saturation, displacement of residual oil with injected oil, and displacement of residual water with injected water. Systematic differences in the shape of effluent concentration profiles and the values of dispersion coefficients calculated from them were observed. Irrespective of which fluid formed the wetting phase, the miscible displacement of residual non-wetting phase showed very early breakthrough and poorer recovery efficiency when compared to miscible displacement of residual wetting phase. Furthermore, miscible displacement at 100% saturation showed significantly smaller dispersion compared to miscible displacement of the residual phases. 11 refs., 6 figs., 21 tabs.

50622 (PRI—1984-5) Introduction to microbial enhanced oil recovery. Report 1984-5. Ionescu, E. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Oct 1984. 48p. (CE—01829). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In most oil fields, only 30 to 40% of the original oil in place is recovered by conventional methods. With some of the existing enhanced oil recovery (EOR) procedures, this figure can be improved to approximately 60%. Recent developments have witnessed an increased interest in the application of microorganisms and their meatabolic products to the enhancement of oil production. This development has become known as microbial EOR. The objective of this report is to familiarize the reader with microbial methods as applied to enhanced oil recovery and to briefly review the past work in this area. As a result of this introductory survey, it is apparent that microbiological techniques may eventually play a significant role in the enhancement of recovery of oil from the reservoir. The majority of the research done to date has been of a fundamental nature, and the level of information is such that developmental studies leading ultimately to field tests would be appropriate. Since Alberta is Canada's major oil producer, the application of microbial EOR techniques, which are currently generating great industry-wide interest, could prove to be very valuable for extending the life of many pools having marginal production. A study of suspended, abanded, and marginal pool data shows there are a large number of Alberta oil fields where microbial EOR should be considered. 220 refs., 5 figs.

50623 (PRI—1984-6) Polymer flooding in stratified cores. Novosad, E.; Ionescu, E.; Mannhardt, K. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Nov 1984. 35p. (CE—01823). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The effectiveness of any enhanced oil recovery process is influenced by the mixing of injected and reservoir fluids since the oil recovery efficiency of the injected fluids usually deteriorates with dilution. Reservoir heterogeneities affect this mixing, and some of the poorer-than-expected oil recoveries in pilot operations can be related to reservoir heterogeneities. Composite, stratified cores can be used to model heterogeneous systems in the laboratory. Such cores are prepared by assembling two different core materials side by side in a way that assures capillary contact between the fluids in the two core components. This report describes polymer floods in composite cores consisting of Berea sandstone a and silicon carbide. There is an approximate tenfold difference between the permeabilities of these two materials. Pfizer biopolymer Flocon 4800 was used in all of the polymer floods, and the waterflood oil recoveries were compared with the oil recoveries resulting from polymer injection. In addition, polymer floods were conducted in composite cores in which the water-wet characteristics of either one or both materials were altered to predominantly oil-wet by treatment with a Quilon-S solution. Results show that the effectiveness of polymer flooding is enhanced in oil-wet situations. 8 refs., 16 figs., 3 tabs.

50624 (PRI—8407) A review of Alberta-Canada Energy Resources Research Fund. Project no.2. Enhanced recovery of conventional crude oil. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Jul 1984. 91p. (CE—01830). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Work is being conducted in Alberta on methods to recover heavy oils by using steam, on a number of topics relating to recovery of oil from underground reservoirs by chemical processes as well as the area of enhancing oil recovery by gas flooding particularly with gases such as CO/sub 2/ or mixtures of CO/sub 2/ and SO/sub 2/, and on techniques that can cause injected fluids to sweep through a reseroir with greater oil-recovery effectiveness. Much of the work in these areas was carried out in the form of laboratory experiments. Field tests were also carried out using steam injection, polymer flooding, and miscible flooding. This report contains a detailed summary of all research and work done in the aforementioned areas of investigation. At the conclusion of this report, a list is presented of all the reports and publications through which the information and knowledge gained as a result of the research activities has been conveyed to others 50 refs.

50625 (PRI—PRI1983-2) David Lloydminster, a pool mobility control by polymer flooding. Primary report, 1982-1983. Collins, H.N.; De Bree, C.; Lim, T.H. (Petroleum Recovery Inst., Calgary, Alberta (Canada)). Jun 1983. 158p. (CE—01799). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This study recommends that a single well test be undertaken involving the injection of the polymer N-Hance 325 into the David Lloydminster A Pool in Alberta. This recommendation is based on incremental recoveries of oil over waterflood as observed in the laboratory and predicted by means of a polymer simulation model. The laboratory tests were linear displacements using cores and

fluids from the David pool. The polymer data were used in the Intercomp Beta 1.5 polymer model to predict performance. The performance was measured in terms of incremental income over what would have been obtained by waterflood. Based on a geological study and the reservoir pressure behavior under primary depletion, good lateral communication within the reservoir was expected. The polymer predictions were made using a one-eighth of a 5-spot pattern. A line drive pattern was also investigated. The petrophysical study identified two rock types, the one of better quality being associated with the centre of the pool, the other toward the periphery. The better quality rock also yielded more incremental profit than the other rock. It was possible to develop a simple means of extrapolating the pattern data to the entire pool from a knowledge of the percentage distribution of the rock types. Upon satisfactory completion of the single well test a field implementation of polymer injection should be planned. 16 refs., 56 figs., 39 tabs.

50626 (SEM/PN—87-2) Reservoir performance chart, 1986. (Saskatchewan Dept. of Energy and Mines, Regina (Canada). Petroleum and Natural Gas Div.). 1987. 504p. (MICROLOG—88-02599). Saskatchewan Legislative Library, Government Publications, 234 Legislative Bldgs., Regina, Sask., Canada S4S 0B3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report consists entirely of numerical data, in graphic form, on oil production (cumulative and average) and water injection, as applicable, for oil fields in Sakatchewan. These are arranged by area and oil grade (light, medium, heavy) and within each grade the data are presented alphabetically by pool name.

0204 Processing

REFER ALSO TO CITATION(S) 50491, 50708, 50713

50627 (CISL—8303) Fuels processing R & D in Canada. (Corpus Information Services, Toronto, Ontario (Canada)). Mar 1983. 126p. (CE—01827). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This inventory has been organized to describe research and development capabilities and acitivities in two specific categories of liquid fuels processing in Canada. The category of petroleum processing covers all aspects of petroleum (including synthetic crude) refining that are of potential interest for the production of liquid transportation fuels. Related processes that do not strictly fit this definition, such as bitumen upgrading, were also included. The other category, liquid fuels from gaseous feedstocks, covers all aspects of the conversion of natural or synthetic gases to liquid fuels. This definition includes the conversion of intermediates, such as olefins and alcohols, but excludes the gasification of solid or liquid feedstocks. Data were collected from questionnaires mailed to 98 organizations, including government departments, universities, research facilities and independent laboratories. The investigation involved two questionnaires, one for expertise and facilities, the other for current and planned R & D. It will be noted that there are not very many R & D projects. Several of the private sector facilities work primarily on the development of proprietary processes. The information has been stored in a microcomputer system, using a database management system described in the third part of this report. A following section provides a quick reference to the organizations' capabilities according to services provided, process expertise, feedstock expertise and equipment.

50628 (LU/DCE—8702) Adsorption of nitrogen compounds on zeolites. Final report. Rodrigo, L.; Kallaguine, S. (Laval Univ., Quebec City (Canada). Dept. of Chemical Engineering). Feb 1987. 236p. (MICROLOG—88-03139). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Heterocyclic nitrogen compounds present in crude oil cause problems such as catalyst poisoning. These compounds are usually removed from a feedstock by costly hydrotreatment processes. Selective adsorption in a packed bed may provide a simple alternative. The objective of this study is to determine the magnitude of such parameters as effective diffusivities and adsorption coefficients for nitrogen compounds on zeolite adsorbents, using a chromatographic pulse response technique. Data using this technique were obtained with several nitrogen compound (pyridine or pyrrole)/zeolite systems. A parameter estimation technique was developed that could be applied to the characteristic nonlinear behavior of such systems. This method used finite differences to solve the model equations, coupled to a nonlinear least square routine for optimization of transport parameters. The computer programs developed were tested using chromatographic pulse response data in the literature for a N/activated C system. The optimized transport parameter values were found to be in excellent agreement with those given in the literature. Application of the developed method to the N/H-mordenite system did not meet with the same success. The initial poor performance of the method was caused by poor choice of several parameters such as the time step and number of column and particle nodes. Although the developed method was tested with a linear model, the programs can be modified to treat nonlinear models and also to take into account the bidispersed pore structure of commonly used zeolite adsorbent. 41 refs., 95 figs.

50629 (OU—87) Dearomatization of synthetic crude. Final report. Alper, H. (Ottawa Univ., Ontario (Canada)). 1987. Vp. (MICROLOG—88-03393). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

It was found in this investigation that dearomatization of synthetic crude can be achieved by the use of rhodium(I) catalysts operating under phase transfer or homogeneous conditions. The dearomatization is complete, provided the synthetic crude is first subjected to desulfurization by the use of molybdenum carbonyl pre-deposited on acid washed silica or Florisil. There is a considerable induction period prior to dearomatization. One can assume that the induction period is related to the time required to generate the catalytically active metal hybride. The most effective rhodium catalysts are the dimer of chloro(1,5-cyclooctadiene)rhodium and cationic 1,5-hexadiene-1,10-phenanthrolinerhodim chloride. The use of high concentrations of either of these catalysts results in efficient dearomatization but, considering the high cost of rhodium, this process has no commercial potential. In summary, unless one is able to achieve dearomatization without prior desulfurization, this rhodium(I) catalyzed reaction, although novel in concept and simple in execution, has little, if any commercial potential. 5 tabs.

0205 Products And By-products

50630 (PB—88-213681/XAB) Field evaluation of latex-modified asphalts. Report for August 1985-July 1987. Morian, D.A.; Arellano, J.L. (Pennsylvania Dept. of Transportation, Franklin (USA)). Jul 1987. 28p. (REPT—83-42). NTIS, PC A03/MF A01.

The purpose of this project was to evaluate latex rubber used to modify an ID-2 wearing course on LR 88, Erie County, and seal coat and surface treatments used as SAMIs on LR 238, Mercer County. This report covers the construction of these materials. The latex-modified ID-2 was paved using standard paving equipment. Precautions were taken to avoid tracking the material by the paver and rollers. The cost of latex-modified ID-2 is approximately 14% higher than the cost of standard ID-2 used on the project. The latex-modified bituminous seal coat and surface treatment were applied using standard seal coat equipment. No problems were encountered during the construction of these SAMIs. The latex-modified seal-coat and surface treatment cost approximately 33% and 20% (respectively) more than their standard counterparts.

50631 **(PCPP/R—SP88-20) Investigation of process conditions for the synthesis of liquid distillates from light olefins and methanol.** Lennox, R.K.; Tharby, R.D.; Engblom, J. (Petro-Canada Products, Sheridan Park, Ontario. Research and Development Centre). Mar 1988. 164p. (MICROLOG—88-03391). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Process conditions for the production of methyl tertiary butyl ether (MTBE), tertiary amyl methyl ether (TAME) and tertiary hexyl methyl ether (THME) from olefinic feedstocks and methanol were investigated as a means of restoring lost octane quality potential. Gasoline product quality parameters were determined and experiments were conducted on the various ether synthesis processes. The effects of the produced ethers in gasoline blends were also evaluated. Computerized linear programming (LP) involving a typical Canadian refinery was used to assess the economics of the ethers as octane enhancers for gasoline. It was found that MTBE production and subsequent gasoline enhancement was not economically practical. TAME processing indicated a small profit under present refinery design with currently used antiknock additives being allowed into gasoline. LP predictions for THME were not carried out, as virtually no octane improvement was recorded for THME vs the precursors from which it was derived. In the study case refinery, installation of an isomerization process was required to upgrade the naphtha octane quality and to allow the use of this product stream as a gasoline blending component; this led to the refinery having sufficient octane capability to dispense with both ether processing and antiknock additive enhancement. The economics of on-site MTBE, related to the available olefin supply, means refineries producing excess olefins appear to have economic advantage over the study case refinery. The role of MTBE and TAME purchase or on-site production may lie in the application of a final octane trimming operation or as an additive to a specialty product. 31 refs., 34 figs., 56 tabs.

0206 Health And Safety

REFER ALSO TO CITATION(S) 51850

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 50610, 50611, 50612, 50613, 50619, 50626, 51398, 51399, 51416

50632 **(CRIE-Y—87004) Analyses of consumer's feelings, attitudes and needs related to energy services.** Ono, Kenji; Morikiyo, Takashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jul 1987. 47p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752071/JAW.

Nationwide surveys on consumers' feeling to energy services were conducted in 1985 and 1986. Details of the surveys were: age, sex and residential areas of consumers; their desires and values in daily life; image and price feeling of electricity, town gas and petroleum; and feelings related to services by utilities. Data of the surveys were analyzed by multivariate analysis and other methods, and the following results were obtained. Main factors that define energy image are benefit factor such as comfort and clean and cost factor such as economy and energy saving. Life-styles of consumers were abstracted and for each life-style characteristics of feelings and needs related to energy services were clarified. More consumers than in other energy sources feel that electricity is comfortable and clean, but highpriced. This tendency is especially remarkable in housewives of middle age. (20 figs, 11 tabs, 5 refs)

50633 **(DOE/EIA—0109(88/06)) Petroleum Supply Monthly, June 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Aug 1988. 111p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88016247/JAW.

Data on supply and demand for petroleum is presented. Total US demand for petroleum products (as measured by product supplied) averaged 17.1 million barrels per day in June 1988, more than 0.9 million barrels per day above the average for May and 0.2 million barrels per day above the average for June 1987. For the first 6 months of 1988, total US demand averaged 17.0 million barrels per day, 2.9 percent higher than for the comparable period in 1987. Other highlights include the following: Finished motor gasoline demand for June was 7.8 million barrels per day, the highest monthly level recorded since August 1978. Crude oil imports (excluding SPR) for the first 6 months of this year averaged 4.9 million barrels per day, 0.7 million barrels per day, or 17.4 percent, above the average for the first 6 months of 1987. Refinery utilization averaged 83.9 percent in the first half of 1988, compared with 81.6 percent for the first half of 1987. During June, drought conditions along the Mississippi River and its tributaries had no major impact on the petroleum industry's ability to produce and deliver petroleum products.

50634 **(DOE/EIA—0380(88/06)) Petroleum marketing monthly, June 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 2 Sep 1988. 216p. NTIS, PC A10/MF A01 - GPO; 1; GPO Dep. Order Number DE88016882/JAW.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

50635 **(ECC—88) Petro-Canada: its role, control and operations.** Halpern, P.; Plourde, A.; Waverman, L. (Economic Council of Canada, Ottawa, Ontario). 1988. 142p. (In French). (MICROLOG—88-02811). Economic Council of Canada, PO Box 527, Stn. B, 333 River Rd., Ottawa, Ont., Canada K1P 5B6; $9.95 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study examines the emergence and development of Petro-Canada, its objectives and activities, and how these have changed over time. The history of the company is analyzed to determine how and why changes in direction occurred. To determine how Petro-Canada was perceived by the rest of Canada's oil and gas industry, the effects of this Crown corporation's creation and development on the share prices of firms in this industry are examined. Next, the financial performance of Petro-Canada is compared to the performance of other integrated oil companies. Some ad hoc adjustments are made to the raw data to try and capture the impact of Petro-Canada's status as a Crown agent on its financial performance. Examination of the relationship between Petro-Canada and its parents (government and voters/taxpayers) focuses on the nature and effectiveness of control mechanisms designed to evaluate Petro-Canada's role and managerial performance. Finally, a number of policy strategies are offered concerning Petro-Canada's future development, its role in Canadian energy policy, and the nature of its relationship with the federal government. This study is of a Crown corporation in transition, one formed in the heat of an energy crisis, and one which may find its days as a Crown corporation numbered. It is a study in political economy - how economic imperatives interfere with political desires and vice versa. Most of the study deals with Petro-Canada's original objectives, expressing concern as to their vagueness, conflict, and potential for manipulation by a self-serving management. Means are suggested to monitor and control the firm's various roles, and to evaluate its efficiency. 115 refs., 22 figs., 26 tabs.

50636 **(ESC-WR—88-16) Comparative evaluation of environmental costs borne by the refining industry in Belgium, F.R. Germany and The Netherlands.** Van Oostvoorn, F. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jun 1988. 20p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 10. Annual international IAEE conference 'Energy and economic growth revisited', Luxembourg, 4-7 July 1988.

This paper is concerned with the cost impact on the refining industry in Belgium, F.R. Germany and The Netherlands from environmental legislation. It contains an inter-country comparison of environmental costs borne by the refining industries in the three countries in 1993. In 1992 a free internal market within the EC will be effectuated and this calls for equal environmental legislation for industries which are strong competitors on the oil product market in Western Europe. The cost differences are substantial, in particular between Belgium and the other two countries, because the environmental standards are different. As a result product prices differ between the countries and thus environmental standards and laws ought to be harmonized before 1993. 2 figs., 8 refs., 7 tabs.

50637 (IEE—8701, pp 1-31) **International condition of oil after the OPEC general assembly.** Toshi, Tsutomu. (The Inst. of Energy Economics, Ibaraki, Japan). Jul 1987. (In Japanese). Inst. of Energy Economics, 1-18-1, Toranomon, Minato-ku, Tokyo.

In Materials of the 217. Regular Study Meeting.

The 81st OPEC General Assembly was held on June 27, 1987. The national production quota of crude oil from July to September 1987 decided in the assembly is as follows (per day): Iran: 23,690,000 barrels, Saudi Arabia: 4,343,000 barrels, Nigeria: 1,301,000 barrels, etc. Each quota is a little bit bigger than that of the last time, and the total amount of all 13 OPEC countries is 16,600,000 barrels. These figures show a compromise between the radicalists and the moderates. Iraq did not accept its quota and plans to increase its production. As to the oil price, OPEC strongly confirmed to keep the price at 18 dollars per 10 thousand barrels. The biggest problem for the stable supply of oil in the world afterward is the Iran-Iraq War which is becoming increasingly intricate. Japan, the US, and Europe rely on the Strait of Hormuz very much and whether the war grows more intense or ends will influence the oil price considerably. (27 figs, 12 tables)

50638 (IEE—8701, pp 35-63) **Present state of oil trading in oil producing countries.** Iwasaki, Tetsuya. (The Inst. of Energy Economics, Ibaraki, Japan). Jul 1987. (In Japanese). Inst. of Energy Economics, 1-18-1, Toranomon, Minato-ku, Tokyo.

In Materials of the 217. Regular Study Meeting.

The quantity of the oil supplied to the free world was estimated. In this estimate, two categories -- crude oil and oil products -- were considered. The quantity from OPEC countries are estimated as follows: The crude oil export from OPEC countries in the middle of 1986 was 13,380,000 barrels per day. This holds 84.8% of all that from the Middle East, Africa, Indonesia, and Latin America. On the contrary, the export of oil products was 1,030,000 barrels per day and holds 16.1%. The changes in the way oil was sold by OPEC countries are as follows: The Net-Back sales, (the crude oil price is decided on the basis of the net-back value determined by the oil product price), which was 5,680,000 barrels per day (36% of all), dropped to zero in the middle of 1987, and instead, the GSP sales reached 4,990,000 barrels per day (37.1% of all) in the middle of 1987. These changes are noteworthy. (9 figs, 8 tabs)

50639 **(IEE—8701) Materials of the 217. Regular Study Meeting.** (Institute of Energy Economics, Tokyo (Japan)). Jul 1987. Vp. (In Japanese). Inst. of Energy Economics, 1-8-1, Toranomon, Minato-ku, Tokyo.

Selected papers have been processed separately for inclusion in the Energy Data Base.

50640 **(LA—11313-MS) Dampening turmoil in the oil market.** Smith, R.L. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 9p. (CNSS/Papers—12; CONF-8709327—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015473/JAW.

From 11. meeting of the international scientific forum on fueling the 21st century: today's approaches to solving tomorrow's problems; Moscow, USSR (29 Sep 1987).

This paper discusses the history of the 1973--1974 and 1979--1981 oil price rises in the context of crisis management. Strategic Petroleum Reserve use policies are evaluated as is the problem of rising commercial inventories, which were a symptom of the two crises. 5 tabs.

50641 **(NAL-TM—569) Consideration on fuel costs for recent airlines.** Tanabe, Yoshikazu. (National Aerospace Lab., Chofu, Tokyo (Japan)). Apr 1987. 22p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770167/JAW.

There have long been voices calling for a decrease in energy consumption in the commercial airline industry. Though successful efforts have been made in various areas of the industry, resultant achievements cannot be said to be widely known. Here, published data are examined and studies currently made in pursuit of reduction in energy consumption are reviewed. In U.S. airline companies during the period from the first quarter of 1985 to the second quarter of 1986, the flight rate was 0.07-0.25 km/kg and the flight rate multiplied by the number of paying passengers was 7-27 passengers'km/kg. The flight rate multiplied by the weight of paying load was mostly in the range of 1-3 x 10^3 kg'km/kg while fuel accounted for 25-63 percent of the overall costs. In such a situation, some U.S. airline companies have started to replace large airplanes with medium-sized ones, which consume less fuel, because an increase in the number of flights of large airplanes on a route will lead to a decrease in boarding rate, resulting in a decrease in productivity. (12 figs, 21 refs)

50642 **(STEV—1987-7) LPG - Supply and demand up to the year 2000.** (Statens Energiverk, Stockholm (Sweden)). Aug 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754440/JAW.

Production-transport of LPG and its chemical properties are first described. The market developments for LPG up to year 2000 are then treated. The supply is expected to increase by 20-40%, demand in the West is growing more slowly and the LPG prices will remain under pressure to the end of the century. Western Europe will remain self-sufficient in LPG, Japan and North America will become increasingly dependent on LPG from the Middle East and North Africa.

0208 Waste Management

REFER ALSO TO CITATION(S) 50491, 50670, 51796

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 50636

50643 **(DFOW—8804) The effect of winter pipeline construction on the fishes and fish habitat of Hodgson Creek, N.W.T.** McKinnon, G.A.; Hnytka, F.N. (Bowater Newfoundland Ltd., Corner Brook (Canada)). Apr 1988. 50p. (MICROLOG—88-02979). Canada. Dept. of Fisheries and Oceans, Scientific Information and Publications Branch, 200 Kent Street, 12th. Floor, Ottawa, Ont., Canada K1A 0E6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

During the winter of 1984/85 a 30.5 cm diameter underground pipe was built across Hodgson Creek, NWT as part of a line from Norman Wells, NWT to Zama, Alberta. The effects of construction and operation of this ambient temperature oil pipeline on fish and fish habitat in Hodgson Creek were studied from 1983 to 1987. There was no detectable effect of pipeline construction or operation on stream discharge, velocity, temperature, dissolved oxygen or water chemistry. Winter bridge construction in December, 1984 increased the instantaneous total suspended sediment (TSS) level from 2 mg/l to 26 mg/l. Seven hours later the TSS level equalled the pre-construction value. Pipeline trenching increased the TSS level from 1 mg/l to 3524 mg/l. Other construction activities including pipe-laying and back-filling produced lesser increases in TSS than did trenching. High TSS levels attentuated quickly both over time and distance; four days after all in-stream construction ceased, the TSS values downstream of the construction site equalled pre-construction values. Twenty- four hour aver-

age deposition in sediment collectors placed 50 m downstream of the pipeline increased from <1 mg/h to 140 mg/h as a result of construction activity. The headwaters of Hodgson Creek provide winter habit for Arctic grayling, slimy sculpin, and a small number of other fishes. Winter pipeline construction across the lower portion of this overwintering habitat appears to have had no effect on the fish which reside there during the winter. It is postulated that the Arctic grayling which overwinter in the headwaters of Hodgson do not comprise a resident population because no mature Arctic grayling were captured there during winter. 36 refs., 11 figs., 12 tabs.

50644 **(EC/Y/C—WN87/88-8) Review and assessment of a spill response exercise undertaken on the MacKenzie River at Fort Simpson, Northwest Territories on June 24, 1987.** Gordon, M. (Environment Canada, Yellowknife, Northwest Territories. Conservation and Protection). Jan 1988. 15p. (MICROLOG—88-03678). Canada. Environment Canada. Conservation and Protection, EP Publications, Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

On June 24, 1987, Interprovincial Pipe Line (IPL) and Esso Resources Canada held a joint spill recovery training exercise on the northeast shore of the Mackenzie River at Fort Simpson, Northwest Territories. Spill team members included IPL and Esso staff and contracted labourers from Fort Simpson. The scenario for the exercise was the rupture and complete loss of product from the river pipeline crossing. Booms and skimmers were used in containing a simulated spill. Several problem areas were identified which should be corrected by both government and IPL if IPL's effectiveness in resonding to an oil spill is to be fairly evaluated. These include: the need for the NWT Water Board to clarify the reasons for conducting spill exercises and to issue criteria against which company success can be evaluated; the need for time trials to enable the evaluation of IPL's efficiency in spill response; the need for the practice deployment of portable storage facilities for holding recovered material; the need for common training standard for IPL/Esso staff who supervise oil spill crews; and the need for a standing list of experienced and trained individuals available on short notice for emergency duties with IPL and Esso. 7 figs.

50645 **(EPS—EE-100) Report on the in-tank mixing study.** Godon, A.M.; Milgram, J.H. (Environment Canada, Dartmouth, Nova Scotia. Environmental Protection Service). Feb 1988. 75p. (MICROLOG—88-03016). Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Scale model experiments of mixing in rectangular tanks by line bubble plumes are described with the object being to predict mixing of dispersant into crude oil in full sized oil tanker compartments. Such dipersant mixing has been suggested as an interim treatment measure in case of a remote Arctic oil spill from a tanker. The experimental tank length was a tenth of the length of anticipated full sized tanks. The gas bubble plume was created by air exiting from a line source at the bottom of tanks filled with water. Fluorescein dye was used in the tanks to trace the mixing. From samples of tank fluid collected during the experiments, the average dye concentration variation was calculated and used to describe the amount of mixing left to be completed. Through dimensional analysis it was determined that the Froude number was the most important dimensionless group and the independent variables of the system were defined. The resulting change in mixture during the experiments as the independent variables were varied was noted. The data was nondimensionalized and plotted in log-log form so that a straight line could be fitted through the points. To fit the data, the slope of the line increases when the fluid reaches a partially mixed state. An exponential relationship between average concentration variation and mixing time was derived. Dispersant mixing times in full sized tanks containing crude oil are predicted. Experiments with oil and dispersant were conducted. The degree of mixing was measured using a radioactive tracer in the dispersant. No significant differences were noticed between oil mixing and water mixing for similar high Reynolds numbers. The dispersant concentration variations with time in light crude, agree with the mathematical model predictions. The model could not be used for a viscous oil such as cold Bunker. 3 refs., 29 figs., 2 tabs.

50646 (JCCP—8601, pp 21-42) **Environmental measures in oil refineries.** Mar 1986. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88770151/JAW.

In Proceedings of the JCCP international symposium on the petroleum industry protection.

This report is a summary of panel discussion concerning environmental measures in oil refineries. Summarized here are country presentations from the United Arab Emirates, Algeria, China, Iran, and Nigeria, comments by Japanese panelists from four petroleum companies, questions, answers, and discussions, and summary by the session moderator. The country presentations centered on waste disposal and measures taken against noise, water pollution, and air pollution. The panelists' reports mainly concerned legal control, organizations and framework for environmental protection, and pollution control systems, including hardware and software. Questions and answers legal framework and practice in Japan for pollution control. The moderator, when summarizing the panel discussion, stressed the importance of foresight of and early response to environmental problem. (10 figs, 1 tab)

50647 (JCCP—8601, pp 43-53) **Environmental problems and preventive measures in the distribution and consumption of oil products.** Mar 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88770151/JAW.

In Proceedings of the JCCP international synposium on the petroleum industry and environmental protection.

This report is a summary of panel discussion concerning environmental problems and preventive measures in the distribution and consumption of oil products. Summarized here are country presentations from Mexico, Korea, Indonesia, and Qatar, comments by four Japanese panelists from petroleum companies, questions, answers, and discussions, and summary by the session moderator. The country presentations centered on oil spillage on roads and in sea during transportation. emission of SOx, NOx, heavy metals, and black smoke from automobiles and industrial plants, discharge of oil residues, chemical waste, and garbage from vessels, and measures taken against these problems. The panelists' reports mainly concerned framework, legal regulations, and systems for solving environmental problems. Questions and answers focused on specific technical problems. The moderator, when summarizing the panel discussion, stressed the necessity of international cooperation for solving environmental problems. (1 figs, 2 tabs)

50648 (JCCP—8601, pp 54-62) **Environmental protection and petroleum business.** Mar 1986. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88770151/JAW.

In Proceedings of the JCCP international symposium on the petroleum industry and environmental protection.

This report is a summary of panel discussion concerning environmental protection and petroleum business. Summarized here are country presentations from Iraq, Malaysia, Saudi Arabia, and Venezuela, comments by two Japanese panelists from petroleum companies, questions, answers, and discussions, and summary by the session moderator. The country presentation centered on pollution problems and environmental protection policies in each country, national policy regarding environmental problems, and comprehensive planning for environmental protection in specific industrial areas. The panelists' reports mainly concerned the legal framework for environmental protection in Japan and the importance of investment for environmental protection. Questions and answers clarified the problems. The moderator, when summarizing the panel discussion, stressed that environmental problems should be addressed on a global level and that early preventive measures should be taken, and also emphasized the polluter pays principle.

50649 **(JCCP—8601) Proceedings of the JCCP international symposium on the petroleum industry protection.** (Japan Cooperation Center for Petroleum Industry Development, Tokyo). Mar 1986. 78p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88770151/JAW.

Selected papers were processed separately for the Energy Data Base.

50650 (MP—8801) Evaluation of Wright and Wright oil film monitor for detection of offshore chronicle oil discharges. Guptill, F.W. (MacLaren Plansearch Ltd., Halifax, Nova Scotia (Canada)). Jan 1988. 76p. (MICROLOG—88-03003). Environment Canada, Publications Section, Terrasses de la Chaudie@'re, Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A Wright and Wright model DX250 Oil Film Monitor was procured, modified, and installed aboard a semi-submersible drilling rig in Nova Scotia. The modifications included, in part, the connection of a micro-computer to the Oil Film Monitor for the purpose of processing and recording signals internal to the instrument during the experiment. The instrument was evaluated for its suitability as a sensor of chronic or low level oil discharges from an offshore rig. It was concluded that the instrument could function adequately in this role but that it would require further development to make it suitable for operational use. Recommendations are given for such further development. 6 refs., 33 figs., 5 tabs.

50651 (SNV—3034) Survey of processes and pollution of the Stenungsund Petrochemical Industries. Andren, K. (ed.). (National Swedish Environmental Protection Board, Solna). Apr 1985. 60p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754419/JAW.

Processes described: -Steam cracking ethene production. -chlorine production. -Production of vinyl chloride and PVC. -Production of polyethylene. -Production of tensides and amines. -Production of buturaldehyde, octanol and phtalates. -Oilfired power plant, and air and water pollution from the processes.

50652 (STU—86-5093) Natural wear of oil on rocky shores. Jonsson, A.; Broman, D. (Stockholm Univ. (SE). Zoologiska Inst.). (Swedish National Board for Technical Development, Stockholm; National Swedish Environmental Protection Board, Solna). Apr 1987. 34p. (In Swedish). (SNV—3305). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754456/JAW.

One year of erosional processes on oil on four different rocky shores in the northern archipelago of Stockholm has been studied. All the shores face north-east, are differently exposed to waves and drift ice and their slope is either flat or steep. Spots of heavy fuel oil (No 5) were painted at different levels above the water's edge. After twelve months of wearing, the two highly exposed rocks were practically clean from oil between the water line and the five metre level. Significant wearing was noticeable up to the half-meter level on the low exposed and flat sloping rock. The rock with a steep slope were clean from oil only at the water's edge. Due to the high cost of substantial shore-cleaning operations, the National Swedish Board of Rescue and Fire Services recommended that no major efforts to clean up all the oil should be made on shores that are not ecologically or socio-economically important. Results from this study prove that natural erosional processes can be sufficient to remove oil from certain levels on rocky shores in a relatively short time (less than a year). Recommendations are presented on this basis, on which levels above the water's edge that can be excluded from major shore-cleaning operations, even on rocks that are ecologically or socio-economically important. (authors).

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 50616, 50646, 50648, 50649

50653 (BCMEMPR—1986-4) [British Columbia] Petroleum Resources Division. Summary of operations, 1986. (British Columbia Ministry of Energy, Mines and Petroleum Resources, Victoria (Canada)). 1986. 83p. (MICROLOG—88-02608). British Columbia Legislative Library, Government Documents Division, Parliament Buildings, Victoria, B.C., Canada V8V 1X4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The British Columbia Petroleum Resources Division administers the Petroleum and Natural Gas Act, the Geothermal Resources Act, and the Petroleum Underground Storage Act. The Division enforces the regulations made under the three Acts: Drilling and Production Regulations, Geophysical Regulations, Drilling Licence Regulations and Development Road Regulation under the Petroleum and Natural Gas Act; Geothermal Drilling and Production Regulations and Administrative Regulations under the Geothermal Resources Act. The Division is responsible for all matters related to the disposition of provincially-owned petroleum, geothermal and underground storage rights as well as the regulation of the exploration, development, and production phases of the related industries. The Division includes the Engineering and Operations Branch, the Geology Branch, the Titles Branch, a Mediation and Arbitration Board and an Offshore Petroleum Co-ordinator. This report details the activities of the Petroleum Resources Division and the province's petroleum industry during the year. Its purpose is to explain the role of the Division staff and provide persons interested in British Columbia's petroleum industry with an account of the industry's accomplishments. The report is divided into three sections: Petroleum Resources Division organization, review of industry activities, and highlights of Division activities. A series of tables and illustrations forms the last section of the report and provides important information on petroleum industry operations.

50654 (ERCB/C—8806) Summary of orders and approvals issued in June 1988. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). Jun 1988. 17p. (CE—01841). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

This document lists, in alphabetical order by field/area name, the orders and approvals issued in June 1988 by the Alberta Energy Resources Conservation Board. Data are presented in tabular form, and include order number, date, brief description, and the order number that the present order/approval expires or rescinds. Subject matter of these orders/approvals includes gas processing, subsurface disposals, enhanced recovery, and oil/gas production.

50655 (ERCB/C—IL88-9) Sour well licensing and drilling requirements. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 30 Jun 1988. 8p. (CE—01842). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

This document amends and consolidates certain directives relating to sour crude wells in Alberta. Regulations presented in this document cover the minimum distance requirements separating proposed sour wells from residential and other developments. Separation distances are given according to four classification levels which depend on the hydrogen sulfide release rate of the well. Blowout preventer stack specifications are also included. 1 fig., 2 tabs.

50656 (ERCB/C—IL88-12) Modified proration plan. (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 19 Jul 1988. 9p. (CE—01839). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

A modified proration plan was introduced in Alberta in 1987 to help administer crude oil movements in the province. Ongoing problems, including overstating of production and improper ownership verification, have led to the changes in the plan outlined in this document. These changes, as reviewed and approved by shippers, involve a formalized verification process, expanded weekly ticketing to include shipper forecasts, and recommended revisions in tariff rules and regulations to change notice of shipment timing and protect pipelines from legal responsibility arising from such change. Detailed in this document are the information forecast reporting calendar for 1988-89 and a list of responsibilities for crude oil movements administration. The intent of the latter is to establish an orderly communications process to resolve the operational issues of general production forecasting, handling discrepancies, handling short-term apportionment, and handling short term emergencies up to 72 hours.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 50656

0230 Properties

REFER ALSO TO CITATION(S) 50659

50657 **(GCLL—8710) Detailed study of the influence of experimental conditions on retention time in size exclusion chromatography of bitumens/heavy oils/asphaltenes. Final report.** Pandey, R.N. (Guelph Cehmical Labs., Ontario (Canada)). 15 Oct 1987. 116p. (MICROLOG—88-03145). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This paper investigates one aspect of a common analytical method used for molecular weight determinations in heavy crudes. It studies the effect of secondary interactions on retention time and possible means of reducing such interactions. Based on a literature search, two chromatographic packings and four solvent systems were selected for their potential success in reducing secondary interactions, and a series of experiments with model compounds were performed to study the variations of retention time as a function of experimental conditions. The model compounds studied represent various classes of compounds present in heavy crudes, such as saturates and polynuclear aromatics. Five heavy crude samples were studied, including determination of number average molecular weight by vapor pressure osometry (VPO) and freezing point depression (FPD) methods. Model compound studies on polystyrene gel packings show lack of correlation of retention data onto a single calibration line. Studies with deactivated silianized silica packings show that secondary effects can be minimized or prevented in o-xylene and 1,2,4-trichlorobenzene solvent systems. These two systems were therefore used for determining molecular weight distribution of the heavy crude samples. Accuracy of the size exclusion chromatography molecular weight method is compared with VPO and FPD molecular weight values and the limitations of the method discussed. 17 refs., 37 figs., 24 tabs.

0240 Storage

REFER ALSO TO CITATION(S) 50619

0250 Combustion

REFER ALSO TO CITATION(S) 52082

50658 (IZ—8601, pp 12-14) **Explosion in heterogeneous media.** Oyagi, Shigeharu; Harigaya, Yasuo; Yoshihashi, Teruo. (Saitama Univ., Faculty of Engineering, Urawa, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji.

Experiments of igniting kerosene liquid droplets with relatively large sizes (about 1 mm diameters) using a blast caused by gaseous detonation and study of the formed combustion wave were conducted to investigate the explosion of atomized fuel in oxidizing gas. For the experiments, equipment consisting of a combustion tube, a drive tube, an atomizer, etc. was elaborated. The condition for starting detonation and the detonation starting process were investigated while changing the nitrogen-oxygen ratio B in the oxidizing gas. Let Spray denote the case of igniting atomized fuel and Film denote the case of igniting adsorbed fuel. When B = O, the difference between Spray and Film is small. When B = 1, the peak pressure is lower in Spray than in Film, and a secondary shock wave is observed behind the leading shock wave in Spray. When the percentage of nitrogen is raised as in B = 1.5 or 2.0, a secondary shock wave appears and the ignition delay increases in Film. When B = 2, combustion is almost unnoticeable in Spray. (3 figs, 8 refs)

50659 **(NIPER—313) Influence of ambient temperature, fuel composition, and duty cycle on exhaust emissions: Final report.** Seizinger, D.E. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Apr 1988. Contract FC22-83FE60149. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001229/JAW.

Vehicle emission tests were conducted to determine the effects of wintertime operating conditions and higher aromatic content fuels on exhaust emissions. The fleet consisted of one methanol-fueled vehicle, one diesel vehicle, and eight gasoline-fueled light-duty vehicles. Exhaust emissions determinations included unburned hydrocarbon (HC), carbon monoxide (CO), nitrogen oxides (NO/sub x/), benzene, formaldehyde, total aldehydes, and particulates. For the gasoline vehicles, emissions of HC, CO, and benzene at 20{degree}F ambient were three to four times the emissions rates at 75{degree}F. Formaldehyde and total aldehyde emissions were about 30 percent lower at 20{degree}F ambient. The diesel vehicle had the same directional responses, but the absolute effect of ambient temperature on exhaust emissions rates was much less than that for the gasoline vehicles. The emissions of HC, CO, and benzene from the methanol vehicle at 20{degree}F were an order of magnitude greater than the emissions rates at 75{degree}F. Increasing the aromatic content of the fuel typically resulted in higher emissions rates at all test temperatures. The only notable exception was formaldehyde, which decreased at the lower temperatures for the gasoline vehicles. Additional tests that incorporated a 5-minute idle immediately prior to the regular driving cycle resulted in lower emissions rates over the driving cycle. The emissions rates of HC and CO on a per unit time basis during the extended idle period were about half those during the warm-up phase of tests which omitted the idle. Formaldehyde emissions, on average, were about the same for cold idle and cold transient at the 20{degree}F ambient. 2 figs., 5 tabs.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 52456

50660 **(DOE/FE/60600—T18-Vol.1) Dry Gas Zone, Elk Hills Field, Kern County, California: General reservoir study: Geologic text and tables: Final report.** (Evans, Carey and Crozier, Bakersfield, CA (USA)). 29 Jun 1988. Contract AC01-85FE60600. 174p. NTIS, PC A08. Order Number DE88016033/JAW.

The Dry Gas Zone was defined by US Naval Petroleum Reserve No. 1 Engineering Committee (1957) as "{hor←ellipsis}all sands bearing dry gas above the top of the Lower Scalez marker bed. The term is used to include the stratigraphic interval between the Scalez Sand Zone and the Tulare Formation - the Mya Sand Zone. The reservoirs in this upper zone are thin, lenticular, loosely cemented sandstones with relatively high permeabilities." Other than the limited Tulare production in the western part of the field, the Dry Gas Zone is the shallowest productive zone in the Elk Hills Reserve and is not included in the Shallow Oil Zone. It is Pliocene in age and makes up approximately eighty percent of the San Joaquin Formation as is summarized in Exhibit TL-1. The lithologic character of the zone is one of interbedded shales and siltstones with intermittent beds of various thickness sands. The stratigraphic thickness of the Dry Gas Zone ranges from 950 to 1150 feet with a general thickening along the flanks and thinning over the crests of the anticlines. The productive part of the Dry Gas Zone covers portions of 30 sections in an area roughly 10 miles long by 4 miles wide. 4 refs.

50661 **(DOE/MC/23145—2616) Gas hydrate research in the Gulf of Mexico: Final report.** Bennet, R. (Columbia Gas System Service Corp., Columbus, OH (USA)). May 1988. Contract AC21-86MC23145. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010279/JAW.

The high energy seismic sections on the continental slope showed no evidence of a Bottom Simulating Reflector (BSR), which would indicate the presence of gas hydrates. There was no

indication of metastable hydrates in continental shelf or slope sediments outside of the conventionally accepted temperature and pressure environment. Tracing the path of migrating gas from the source is much more straight forward than intercepting gas being transported and tracing it back to the source. Our study of low and medium energy seismic methods has shown that they could identify migrating gas. We feel strongly that there are hydrate zones in the Gulf of Mexico that are decomposing; they build up pressure and periodically release the trapped hydrocarbon gases. The released gases migrate vertically and/or laterally to mix with other types of gas or to form discrete pockets. Some of this gas may be emitted from underwater seeps into the overlying water column where it could be identified by a geochemical survey. The ratio of isobutane to normal butane determined by the geochemical survey can be used to assess the probability of the hydrocarbons emanating from a hydrate source. (The more the ratio exceeds 1.0 the greater the probability that the gas could be from a hydrate source.) As no indications of a hydrate zone (e.g., a BSR) were located, we were not able to establish a geophysical signature for gas hydrates; but the records indicate there are large volumes of gas migrating up the continental slope, some of which may have originated from a decomposing hydrate zone or from gas trapped below the hydrate cap. 20 refs., 13 figs., 1 tab.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 50608, 50617

50662 **(ERCB/C—D88-9) Chevron Canada Resources Ltd. ICG Resources Ltd. gas processing facilities in the Acheson Field. Interim decision D88-9.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 2 Jun 1988. 1p. (CE—01840). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

A hearing was held to consider an application to construct a gas processing plant and to enlarge another existing gas plant, both located in Alberta. Both facilities were to be designed to produce the same volume of residue gas and ethane-plus mix from essentially the same raw gas sources. An agreement was reached between the two applicants that Chevron was to purchase the ICG facility, thus resulting in only the new Chevron plant being built. The Energy Resources Conservation Board was satisfied that there is a need for additional gas processing capacity in the proposed location, that only one facility is required to meet this capacity, and that the facility as described in Chevron's application is approved. The approval is conditioned to the effect that total sulfur recovery would have to be implemented if other measures for acid gas disposal were found to be unsuitable.

0304 Products And By-products

REFER ALSO TO CITATION(S) 50627, 51575

0305 Health And Safety

REFER ALSO TO CITATION(S) 50671

50663 **(PB—88-222872/XAB) Experimental study of suppression of obstructed gas well blowout fires using water sprays. Final report.** Chauvin, M.R.; Bourgoyne, A.T. (Louisiana State Univ., Baton Rouge (USA). Dept. of Petroleum Engineering). Jun 1988. 54p. NTIS, PC A04/MF A01.

The effect of obstructions in the gas flow on the ability of water sprays to extinguish simulated gas-well blowout fires was examined using test fires with natural gas flow rates up to 35 MMSCF/D. The series of tests extends previous measurements of water-spray extinguishment of simulated un-obstructed natural gas blowout fires adding obstructions that would almost certainly be present during accidents on actual platforms. It was found that the presence of obstructions in the gas flow increased the amount of water needed to extinguish the fire compared to an unobstructed blowout fire. It is believed that an obstruction increases air/gas mixing while at the same time it decreases water/gas mixing.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 50632, 50635, 50673, 50675, 50676, 50677, 50678, 51398, 51426

50664 **(CGA—8710, pp 8) Buying gas with C.M.P.'s.** Dunk, C. (Stelco, Inc.). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

Stelco is Canada's largest steel producer, using over 23 billion cubic feet of natural gas annually. This paper describes Stelco's experience with purchasing gas on contracts conducted under the Competitive Marketing Program, a mechanism by which gas producers provide specific discounts to individual end users. Experience has shown that these types of contracts are administratively easier than direct purchase. As with direct purchase, pricing can be renegotiated under certain circumstances and recognition is given for corporate volumes. Also discussed are requirements for choosing a natural gas supplier; these include reliability, flexibility, and the ability to communicate with the customer.

50665 **(CGA—8710, pp 12) Marketing gas under the new regime.** MacMurchy, N.E. (Department of Energy, Alberta). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

This presentation discusses natural gas marketing in Canada from an Alberta government perspective and taking into account the changes in market conditions under new policies that had the objectives of establishing a market-oriented pricing regime. Specifically, these new policies contemplated the enhancement of possibilities for direct negotiations between buyers and sellers. They were formulated at a time when there was a known surplus of supply, hence the possibility that a change to market-oriented pricing could result in a large drop in price, with serious consequences to the industry. A balance between the interest of producers committed to long-term investments and the interest of those who had not had previous access to markets outside Alberta was therefore necessary. The results of this new situation have seen increased activity by Alberta producers in other markets, although the export market to the USA is still not completely competitive. Most of the gas is flowing under relatively short contracts. As the market situation matures, it is expected that long term contracts will reappear.

50666 **(CGA—8710, pp 14) Remarks for the Marketing Conference of the Canadian Gas Asssociation.** Horton, W.R. (Canadian Utilities Ltd.). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

This presentation discusses the natural gas industry in Canada and its new marketing opportunities as influenced by changes in regulatory policies. A primary result of these new policies has been the ability of end users to negotiate directly with suppliers, leading to new challenges to the gas industry in the areas of customer servicing. A number of recommendations are made, from the industry viewpoint, on issues relating to the fair treatment of customers and suppliers. These issues involve the determination of which customers should be protected by contracts that ensure long term supply security, definition of the 'core' market, contracting practices, availability of transportation service, and the general objectives of government policy.

50667 **(CGA—8710) C.G.A. 1987 Marketing Conference.** (Canadian Gas Association, Don Mills, Ontario). 1987. 210p. (CONF-8710371—). Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ont., Canada M3B 2R3; $0.25 PER PAGE CAN.

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

A conference was held on marketing natural gas in Canada. Presentations were made on topics relating to government policies, gas purchasing, gas appliances, energy conservation in houses, and natural gas as engine fuel. Separate abstracts have been prepared for eight papers from this conference.

50668 **(DOE/EIA—0130(88/06)) Natural gas monthly, June 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 30 Aug 1988. 139p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88016488/JAW.

This monthly report on the natural gas industry covers: dry gas production (wet marketed production minus extraction loss); consumption of natural gas; the average wellhead price of natural gas; the average city-gate price for natural gas delivered to distribution service areas; and the quarterly survey of 100 natural gas marketers. 7 refs., 6 figs., 37 tabs.

50669 **(ESC-WR—88-17) 17th World gas conference, Washington, DC, USA, 5-9 June 1988. Energy policy makes and breaks the gas market.** Koenders, N.J. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jul 1988. 23p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report is based on lectures presented on the 17th World Gas Conference held in Washington from 5-9 June, 1988, information from some technical sessions, the exposition and informal chats. Successively the following items are discussed: optimism about the future of natural gas; spectacular growth of natural gas supplies; uncertainties about gas supplies in Western Europe. Then some technological developments are discussed. Also attention is paid to problems in less developed countries concerning the gas production. It is concluded that these conferences are very interesting and useful for non-technologists. The report ends with a long list of titles from reports and papers presented at the conference. 2 figs.

0307 Waste Management

REFER ALSO TO CITATION(S) 52071

50670 **(SKMC—8802) Review and assessment of current flaring technology.** (SKM Consulting Ltd., Calgary, Alberta (Canada)). Feb 1988. 180p. (MICROLOG—88-03012). Environment Canada, Publications Section, Terrasses de la Chaudiere, Ottawa, Ont., Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Flare systems are widely used for disposal of waste gases from the production and processing of hydrocarbons and other products. There are many different types of flares, which are evaluated in this report. They may be grouped into the two general categories of elevated flares, the most common, and ground flares. Environmental concerns prompted the development of smokeless flares. A more recent development is the staged multi-point flare, providing smokeless combustion and lower radiation levels without external assist. The performance of flare systems with respect to most safety, environmental, and economic criteria is readily observable and assessed. The best practical flare technology takes into account economic considerations, generally on the basis that an intermittent flare will operate at more than 25% of its maximum capacity only a small percentage of the time. Where more than one technology will meet a given objective, the lowest cost one is outlined. To illustrate the effect on costs of the non-smokeless utility flare vs the smokeless varieties, designs and cost estimates for flare systems have been prepared for typical gas processing plants with a central Alberta location. The current regulatory practices in various US jurisdictions are reviewed and compared with Alberta's regulatory requirements respecting flares. Minimum heat contents of the flared gases, required throughout the USA for new continuous flares and in Texas for all flares, are comparable to Alberta requirements. 56 refs., 19 figs., 25 tabs.

0308 Environmental Aspects

50671 **(APSS—8801) Government of Alberta emergency response plan for sour gas release.** (Alberta Public Safety Services, Edmonton (Canada)). 20 Jan 1988. 31p. (MICROLOG—88-02836). Alberta. Public Safety Services, 423 Legislature Building, Edmonton, Alta., Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This plan explains the Government of Alberta's response to a sour gas emergency. The Energy Resources Conservation Board (ERCB) is the lead agency in overseeing government response to the emergency and is responsible for initiating the plan. The industrial operator is required by the ERCB to have a comprehensive emergency plan in place that is initiated as soon as any sour gas release occurs. In the event a release appears imminent, the operator and ERCB will jointly agree on initiating the appropriate plans. This plan includes drilling and operating wells and other sour facilities. Individuals living within a designated emergency planning zone (based on predicted sour gas release rates) are aware of such plans and would be evacuated immediately by the operator if a release occurred. The operator would also commence mobile monitoring for sour gas. An on-site command post is established by the operator to control sour gas release. Local municipalities are advised in the very early municipal and industrial operator's plans must be mutually supportive and co-ordinated. Concurrently, the Government's plan is activated when a sour gas release occurs or is imminent. This plan describes the concept of operations, responsibilities of Alberta Government departments and agencies, and some detailed aspects of the management of the actual emergency. 2 figs.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 50832, 52053

50672 (DOE/METC—87/6080, pp 391-398) **Multiwell Experiment - fracturing experiments.** Warpinski, N.R.; Sattler, A.R.; Branagan, P.T.; Cipolla, C. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. NTIS, PC A22/MF A01. Order Number DE87006490/JAW. (CONF-870728—). Contract AC04-76DP00789.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

The objective of the Multiwell Experiment (MWX) fracturing experiments is to test and develop the technology for the stimulation of lenticular tight gas sands. This requires basic understanding of (1) fracture behavior and geometry in this complex lithologic environment and (2) subsequent production into the created fracture. The intricate interplay of the hydraulic fracture with the lens geometry, the internal reservoir characteristics (fractures, reservoir breaks, etc.), the in situ stresses, and the mechanical defects (fractures, bedding, etc.) need to be defined in order to develop a successful stimulation program. The authors attempt to assess whether conventional fracturing technology is applicable, where improvements are needed and if new technology is required. Project description and results are given and discussed.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 50654, 50662

50673 **(AMTU—8711) Rural Gas Program manual.** (Alberta Ministry of Transportation and Utilities, Edmonton (Canada)). Nov 1987. 29p. (MICROLOG—88-02771). Alberta Transportation and Utilities, Office of the Minister, 208 Legislature Building, Edmonton, Alta., Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The intent and purpose of this manual is to describe the various guideliness and administrative procedures associated with the Alberta Rural Gas Program and to consolidate and expand upon

the legislation under which the Program has been developed. It is intended primarily for the use and information of rural gas distributors, their agents, and other private or government parties having an interest in the Rural Gas Program. Information is presented on: rural gas franchises, technical applications, contracts and tenders, determination of system capital costs for grant support, grants, Gas Alberta brokerage arrangements, insurance coverage, utility rights-of-way, and lien notes.

50674 **(ERCB/C—D88-D) Alberta ethane policy. Report on implementation.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). Apr 1988. 124p. (MICROLOG—88-03562). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An ethane policy was developed by the Alberta government with respect to the gas industry and the Alberta Ethane/Ethylene Petrochemical Project. The Project gets its ethane feedstock largely from straddle plants located on main gas transmission pipelines. Much of this gas comes from upstream gas field plants and has already been processed to recover products other than ethane. Recent demand for ethane in the oil fields has increased the field plants' interest in recovering the ethane themselves, thus creating a dispute around the ownership, or at least the right to extract ethane from, the gas produced in Alberta. In August 1987 a policy statement was issued that established certain rules intended to ensure that industries using ethane would have access to adequate, competitive sources of supply. The basis of this new policy is the setting of a guaranteed threshold volume of ethane that could be extracted and supplied to the Petrochemical Project from its straddle plants. A public inquiry was conducted to hear the views of interested parties, and considered issues such as which ethane facilities should be affected, the principles involved in determining the threshold volume, and determination of procedures relating to applications for ethane extraction at field plants. The key issues as seen by the inquiry participants related to where the threshold volume should be defined, its magnitude, and the terms of reinjection or supply of ethane to the Project to maintain the threshold volume. Recommendations were made by the Energy Resources Conservation Board and were influenced by its conclusion that potential ethane supply is substantially higher than the expected Alberta demand. 5 figs., 2 tabs.

50675 **(OEB—8801) Decisions with reasons in the matter of the Ontario Energy Board Act and in the matter of an application by the Consumer's Gas Co. Ltd. for rates (re: gas costs).** (Ontario Energy Board, Toronto (Canada)). 22 Jan 1988. Vp. (CE—01845). Ontario Energy Board, 14 Carlton St., 9th Floor, Toronto, Ont., Canada M5B 1J2; $17.00 CAN.

A hearing was conducted to examine certain agreements between TransCanada Pipelines and gas utilities in Ontario, and to approve rates for gas sales, transport and storage. These agreements were affected by deregulatory measures and involved such matters as discounts and their disposal, contract volumes, and incentives. Acceptance of these agreements was challenged by the Ontario Energy Board on several grounds, including those of discriminatory pricing. The Board found that the renegotiations over the agreements were constrained by a number of factors, including existing contracts and policies outside of Ontario control. It was felt that negotiations were conducted so as to achieve the maximum benefits possible to the gas consumer, short of precipitating confrontations with the industry and other governments. The agreements were therefore accepted, subject to certain qualifications on rate issues. The rate issues examined in this hearing involve the use of discounts and their levels, including those to non-competitive customers, market responsive pricing, and competitive marketing. Transitional rates were approved for November 1987 implementation. Other issues discussed were sources of supply, winter peaking service, and discretionary purchases. Views of the Board on future issues are expressed, including the concept of a competitive market, decontracting, and security of supply.

50676 **(OEB—8801) Decision with reasons in the matter of the Ontario Energy Board Act and in the matter of an application by Union Gas Ltd. for rates (re: gas costs).** (Ontario Energy Board, Toronto (Canada)). 22 Jan 1988. 115p. (CE—01844). Ontario Energy Board, 14 Carlton St., 9th Floor, Toronto, Ont., Canada M5B 1J2; $17.00 CAN.

Hearings were conducted related to agreements between Union Gas, an Ontario utility, and TransCanada Pipelines/Western Gas Marketing. These agreements set out rates, discounts, contract quantities, tolls, allocation policy and other matters. It was noted that the agreements met the objective of achieving the lowest price for gas for all Ontario customers, and were accepted by the Ontario Energy Board, subject to certain qualifications. A rate issue addressed was whether approval should be granted to the mechanisms developed to determine prices in each of the three market segments in Union Gas's franchise area. The Board reached findings related to the use and effect of discounts and to actions needed to protect and encourage the competitive market that is developing in Ontario. Other findings were made on issues specific to Union Gas. These included balances in deferral accounts, customer rebates, and various aspects of deregulation. Future considerations addressed in this document were the concept of a competitive market, decontracting and self-displacement, and security of supply.

50677 **(NEB-SS—NE22-1/1988-4F) National Energy Board reasons for decision in the matter of Pan-Alberta Gas Ltd.** (National Energy Board, Ottawa, Ontario (Canada)). Jun 1988. 14p. (In French). (CE—01835). National Energy Board, Regulatory Support Office, 473 Albert Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

A hearing was held to consider approval of an application to amend Pan-Alberta Gas's current export license in order to: extend its term by 16 years; increase the term quantity to 73.6 billion cubic meters; and to amend the existing daily and annual authorization levels. The gas proposed for export would be exported through British Columbia to the USA. In the hearing, complaints, export impact assessments, and other factors relating to the public interest were considered, including gas reserves, productive capacity, markets, pipeline facilities, and net benefits to Canada. It was concluded that the proposed export volume is small compared to expected requirements and that it is unlikely the proposed export will cause Canadians difficulty in meeting their energy needs at fair market prices. It was revealed that Pan-Alberta's contracts with its suppliers were being renegotiated to extend the contract terms to correspond with the proposed license term. The requisite provincial removal permits, pipeline facilities, and markets in the USA were all seen to be present. A social cost benefit analysis was submitted to demonstrate the economic benefits to Canada from the proposed exports. As a result of this application, it was decided to issue a new license which would embody the terms and conditions requested by the applicant.

50678 **(NEB-SS—NE22-1/1988-4E) National Energy Board reasons for decision in the matter of Pan-Alberta Gas Ltd.** (National Energy Board, Ottawa, Ontario (Canada)). Jun 1988. 13p. (CE—01834). National Energy Board, Regulatory Support Office, 473 Albert Street, Ottawa, Ont., Canada K1A 0E5; $N/C.

A hearing was held to consider approval of an application to amend Pan-Alberta Gas's current export license in order to: extend its term by 16 years; increase the term quantity to 73.6 billion cubic meters; and to amend the existing daily and annual authorization levels. The gas proposed for export would be exported through British Columbia to the USA. In the hearing, complaints, export impact assessments, and other factors relating to the public interest were considered, including gas reserves, productive capacity, markets, pipeline facilities, and net benefits to Canada. It was concluded that the proposed export volume is small compared to expected requirements and that it is unlikely the proposed export will cause Canadians difficulty in meeting their energy needs at fair market prices. It was revealed that Pan-Alberta's contracts with its suppliers were being renegotiated to extend the contract terms to correspond with the proposed license term. The requisite provincial removal permits, pipeline facilities, and markets in the USA were all seen to be present. A social cost benefit analysis was submitted to

demonstrate the economic benefits to Canada from the proposed exports. As a result of this application, it was decided to issue a new license which would embody the terms and conditions requested by the applicant.

0320 Transport, Pipelines, And Handling

50679 **(AMTU—88) Technical standards and specifications manual for the Rural Gas Program. Design, construction and operation of natural gas distribution systems in rural Alberta. Second edition.** (Alberta Ministry of Transportation and Utilities, Edmonton (Canada)). 1988. 63p. (MICROLOG—88-02770). Alberta Transportation and Utilities, Office of the Minister, 208 Legislature Building, Edmonton, Alta., Canada T5K 2B6; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This manual covers the key aspects of the design, construction and operation which are considered necessary for the orderly and effective development of gas distribution systems in rural Alberta. The scope of this manual includes any part of a gas distribution system within a franchise area which has been approved and issued under the authority of the Rural Gas Act, and any gas distribution pipeline which operates at a pressure of 700 kilopascals or less, is located outside an incorporated urban area, and is defined as a low pressure distribution pipeline within the meaning of the Rural Gas Act. The contents of the manual describe, under system design, establishing peak design loads, sizing, routing, depth of cover and clearance, crossings, and pipelines parallel to local roads. The section on construction covers materials specification and handling, project management, right-of-entry and crossings, and pipeline jointing, installation, warning signs, metering, and cathodic protection. Other sections of the manual deal with regulator stations and isolator valve assemblies, testing and licensing of pipelines, pipeline surveys and plant location records, and operations and maintenance. 33 figs., 2 tabs.

50680 (CGA—8704, pp 20) **PE equipment - development & maintenance in B.C. Hydro.** Chapman, I. (B.C. Hydro). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

This paper describes the experience of a gas utility in British Columbia with polyethylene pipe. It describes the various procedures and tools which have been developed to simplify polyethylene installations, and to maintain the materials and equipment used for these installations. Pipe and fittings are purchased through public tender, and quality control procedures are used to ensure proper material quality in manufacture, transport, handling, and installation. Heaters for pipe fusion are discussed in detail along with maintenance and repair methods. Portable generating equipment associated with such heaters is also evaluated, and experience with heaters, generators, and other tools is summarized, along with various methods that have been found useful in dealing with equipment problems.

50681 (CGA—8704, pp 13) **Pros and cons of plastic pipe systems.** Brooks, E.D. (Union Gas). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

The experiences of an Ontario gas utility with plastic distribution pipe are discussed in this paper. Since 1983 it has used plastic pipe, mostly polyethylene, for all pipelines operating at 420 kilopascals or less. Cost savings over steel pipe are outlined; experience has shown savings in installation costs can take up to 10 years to realize, and maximum real savings of ca 25% have been achieved. A study of leakage has revealed no significant leak problems with plastic systems, any major problems being the result of such factors as improper design and third-party damage. Specific problems relating to connections with service risers, pipe quality control, compressor coupling pullouts and fusion repairs are outlined. Questions still outstanding are summarized; these include the problem of plastic pipe aging, third party damage, repair methods, and procedures for locating plastic pipe. 2 refs., 4 figs., 5 tabs.

50682 (CGA—8704, pp 10) **Static electricity on plastic pipe.** Alden, M. (The Consumers' Gas Company Ltd.). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

This paper examines the possible problems resulting from the accumulation of static electricity on plastic pipe used in natural gas distribution systems. Basics of static electricity are outlined, and current literature on static electricity relevant to plastic pipes is reviewed. Conclusions from this review are presented, one being that electric charges will develop on polyethylene pipes when dust-laden gas flows through them. One report recognized that the most serious situations occur during the repair of damaged or ruptured pipes in service. A study was commissioned by an Ontario gas utility to investigate if the potential exists for a static discharge during a repair of a NTS 1/2 plastic gas service lateral, and to examine electrification of a service tee as a result of dust flow. It was found that under the test conditions, sufficient static charge cannot be developed on a NTS 1/2 lateral sufficient to ignite an air-gas mixture, but the steel cutter located in the service tee developed a very large charge. When the service tee is exposed to air, their is a high probability of discharge when a grounded object approaches closer than 2 cm. As a result of these tests, revised operating procedures were developed for emergency repair of the aforementioned fittings, and a draft of these procedures are included with this report. 4 refs.

50683 (CGA—8704, pp 6) **Pipeline materials.** St. Onge, H. (Duration System Ltd., Ont.). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

The use of steel and plastic as pipe material in natural gas distribution systems is examined. For steel pipe, a major problem is corrosion, and the basics of metal corrosion and cathodic protection are outlined. Means are suggested for optimizing the corrosion protection; it is concluded that a properly engineered steel system, operating within the parameters of cathodic protection, will remain stable in aggressive soils for 50 years or longer. Plastics, on the other hand, cannot be controlled in this way, and depend on built-in stabilizers, quality control during manufacture, and critical field inspection to minimize the effects of aging and environmental stress. Actual time until a major failure is difficult to determine, but experience to date with plastic pipe has been encouraging. 3 refs., 8 figs., 1 tab.

50684 (CGA—8704, pp 9) **Distribution of natural gas to rural Saskatchewan.** Kane, R.G. (Saskatchewan Power Corp.). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

SaskPower is a public natural gas and electric utility serving the province of Saskatchewan. In 1982, it initiated a program to provide gas service to rural areas. This paper gives an overview of the technical, design, and construction aspects of this program. To date, service has been extended to around 40% of the province's cultivated area, and at the present rate of installation (over 8000 km/y) the program is expected to continue another 5-7 years. A fundamental part of the system design was decision to use existing pressure regulating stations as supply sources, and construct a radial distribution system instead of one based on the installation of multiple small reducing stations along high pressure transmission pipelines. Another factor dominating the design process is the low population density and short construction season, requiring high production methods in pipeline installation. This was achieved by using direct ploughing of large reels of polyethylene pipe. Strict quality control of the pipe from manufacturing to field joining have ensured relatively leak-free performance. The ploughing technique also minimizes environmental impacts. Overall objectives of introducing new gas pipeline engineering and construction techniques have been met. The major objective since then has been to reduce unit construction costs. 16 figs.

50685 (CGA—8704, pp 30) **Service risers - design and development.** Ashby, R.M. 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

Service risers are the assemblage of connections that link the natural gas distribution system to the individual customer. With the increased use of plastic pipe in natural gas distribution, a significant development in a new riser products has occurred. This paper describes some of these developments, one of these is the anodeless riser, devised to eliminate the need for cathodic protection in steel risers by ensuring that the steel component is in a non-corrosive environment. This is usually achieved by locating the plastic-to-steel transition at various positions in a steel casing. Three basic groups of this type of riser are discussed: a double sealed riser with the steel carrier pipe component extending below grade inside the plastic; a riser where the plastic comes above grade in a rigid steel casing to a compression connection; and a flexible sheath riser. Application of the service riser to the Canadian gas industry is outlined to show how they are used in the field. A flexible riser developed by an Ontario utility is featured, which had the advantage of avoiding problems associated with ground settlement after building construction; testing and installation of a such a riser is discussed. Resistance of risers to residential fires, and future developments in riser design, are also discussed. 17 figs.

50686 (CGA—8704, pp 7) **Field failures on operating PE gas distribution piping systems.** Pasieclmyk, K.W. (SaskPower). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

This paper describes the experience of a Saskatchewan gas utility with failures in the field of plastic pipe used in its distribution system. Specific failures in older and newer systems are outlined, along with remedial measures. Such failures include manufacturer defects, poor joining workmanship in butt fusions, blockage of socket fusion couplings caused by excessive heat cycles during operation, leaking service tee caps, anodeless riser leakages, and pipe failures at a squeeze. The overall leak rate statistic has been .005 leaks per installed km of plastic pipe, which is considered very satisfactory. The majority of the total number of leaks is caused by third party damage. 2 figs.

50687 (CGA—8704, pp 5) **Field failures of plastic saddle fusions.** Alexander, D. (ICG Utilities (Ontario) Ltd.,). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

In natural gas distribution systems, customer service lines and lateral mains may be connected to new or existing plastic mains by saddle fusion. This involves the use of a heating iron with concave and convex faces for heating the pipe and the fitting. Field failures in these connections can result if careful attention is not paid to the proper procedure and conditions. This paper illustrates some of the problems that exist. Fittings need to be selected properly and properly cleaned. Good fusion also depends on good contact between the heating iron and the surfaces to be heated; this contact can be degraded by improper machining of heater faces, and deformation of heater faces through improper use. Surface contamination has to be removed from pipes and fittings before joining. Correct heating and temperature times must be observed; a sample table of fusion times for TR418 fittings to Aldyl A pipe is given. 6 figs., 1 tab.

50688 (CGA—8704, pp 11) **Detecting flaws in PE pipe built-fusion joints.** Gwartney, W.R. Jr.; McClinton, M. (T.D. Williamson, Inc., Tulsa, OK, USA; Gas Research Inst., Chicago, IL, USA). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

Research is described involving pipe joints in plastic gas distribution piping. It has been demonstrated that the heat fusion technique, if properly performed, will result in a high quality pipe joint having no detectable flaws and with mechanical strength similar to that of the parent material. Bad joints can result from using defective equipment, improper joining practice, and adverse environmental conditions. Visual inspection has been the main method to identify defective joints, but this is limited to identifying external defects only. Detection methods for finding hidden flaws, such as X-ray or ultrasonic techniques, have had major deficiencies. This has led to research in finding a practical flaw detection device that meets the needs of the gas industry. Performance requirements include ease of use, ability to detect small flaws and lack of bonding, and automatic, fast inspection and interpretation of joint quality. A field prototype, capable of detecting all known types of flaws in polyethylene pipe joints, has been developed. Development work is being completed and the new device is called Polyscann. Performance and design specifications for this device are presented; it uses focused ultrasonic transducers coupled acoustically to the pipe by a liquid, is quick and easy to use, and is adaptable to a range of pipe sizes. The device includes an electronic control module for acquiring and processing data from the transducers, with a digital user interface.

50689 (CGA—8704, pp 10) **Quality control of polyethylene pipe systems used for natural gas service.** Schuster, G.F.; Boyko, D.J. (Saskatchewan Power Corp.). 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

The Saskatchewan Power Corporation has been installing large amounts of polyethylene pipe in its rural gas distribution system. As a result of this increased use of polyethylene pipe, the Corporation has given quality control of this product a high priority, from the manufacturing process to the operation of the gas distribution system. This paper describes quality control procedures used during manufacturing, shipping/receiving, installation/construction, and operation/maintenance. The kinds of tests and standards used in manufacturing are outlined, and training requirements for installation personnel are summarized.

50690 (CGA—8704, pp 10) **Electro fusion: state of the art.** Reaney, E. 1987. (CONF-8704320—).

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

Electrofusion fittings for connecting plastic pipe in natural gas distribution systems are assessed, from the point of view of an Ontario gas utility. Such fittings use the heat generated by an electric current passing through the fitting to form the joint. Six brands currently available in Canada are evaluated, and the advantages and disadvantages of electrofusion as a joining method are discussed. Advantages include a lower tooling requirement, less training, ease and speed of joining, and high joint strength; disadvantages include expense compared to traditional fittings, high equipment cost, and lack of experience with the procedures involved. A lack of acknowledged test procedures for electrofusion fittings has led the utility to devise its own test methods, and these are summarized. They include an elevated temperature burst test, tensile and vice tests, and a rotary fatigue test. Overall experience with these types of fittings has been favorable, enabling easier repair of pipes, especially in the larger diameters, under a fair range of operating conditions. 1 fig.

50691 (CGA—8704) **C.G.A. Plastic Pipe Conference.** (Canadian Gas Association, Don Mills, Ontario). 1987. 150p. (CONF-8704320—). Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ont., Canada M3B 2R3; $0.25 PER PAGE CAN.

From C.G.A. plastic pipe conference; Winnipeg, Canada (26 Apr 1987).

A conference was held to examine the use of plastic pipe in natural gas distribution systems. Papers were presented on topics involving pipe installation, safety, testing, pipe joints and joining techniques, pipe manufacturing and quality control, experiences of gas utilities with plastic pipe, repair, maintenance, and system design. Separate abstracts have been prepared for eleven papers from this conference.

50692 (CGA—8705, pp 535-542) **Devices and techniques for supervisory controls and systems (SCADA).** Kern, M. (Fisher Controls International, Inc.). 1987. (CE—01895; CONF-8705317—).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

This paper describes basic devices and techniques for systems used for supervisory control and data acquistion in natural gas distribution systems. Such systems can be divided into the following functional parts: a data base of all the real-time, calculated, and

historical data in the system; a remote telemetry system for retrieval of field signals for the data base; data base validation; reporting of activities and ongoing changes; utilities for describing, documenting, and changing the data base; flexible, interactive interfaces between the operators and the system; a high-resolution, colorgraphic display unit for the data base; a spreadsheet with historical data base access used for compiling reports; and a user-friendly math package for making user-defined calculations. Several of these functional parts are examined in detail.

50693 (CGA—8705, pp 513-521) **Measurement uncertainty - design considerations for a new flow computer.** Brede, C. (ITT Barton Instruments). 1987. (CE—01895; CONF-8705317—).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

This paper reviews, from the perspective of system accuracy, some of the issues which the designers of a gas flow computer must consider. A general consideration is the meeting of the expectation that the flow computer does not contribute significant error to the overall measurement. Bias errors and precision errors are discussed as being the components of accuracy. Analog inputs introduce errors through component errors and changes in components due to outside factors such as temperature. Analog to digital conversion introduces other errors according to the technique used, and proper design involves trading off such factors as accuracy, speed, linearity, resolution, and cost. Errors in analog circuits can be accounted for through autocalibration and loop calibration. Once the analog data is digitized, other errors that can arise include mathematical errors, such as those introduced by rounding off numbers during calculations. Errors can be introduced in the software that interacts with the user. By paying close attention to sources of error in the electronic circuitry, and by employing sufficient numerical precision in the calculations, it is possible to achieve a practical design which contributes minimal uncertainty to the flow measurement. 5 refs., 2 figs.

50694 (CGA—8705, pp 343-379) **Real time measurement implementation and impacts.** Beraud, R. (Nova Corp., Alberta). 1987. (CE—01895; CONF-8705317—).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

For the last 50 years, paper charts have been used extensively for recording information from field gas meters and instrumentation. This data collection method is time consuming and labour intensive. Companies within the gas industry are becoming more and more familiar with real time measurement (RTM) as an alternative to the conventional method, through planning, testing, implementation or in the actual operation of RTM systems for custody transfer. Due to the range and complexity of data requirements, different approaches are being examined for monitoring and collecting gas flow information. These range from the installation of a few simple off-the-shelf flow computers to large scale company wide system integration of hundreds of complex, in-house developed systems. Small off-the-shelf measurement systems require innovative technical people support for the system to work, in selected key areas, in the delivery of measurement information. Large complex in-house systems require management support and direction, as well as a quality project management team, to handle the triple challenge of new technology in the filed, large computer/communication system integration, and staff partiction and acceptance. In the implementation of this new technology, one must deal with issues such as economic justification, staff impact, training, maintenance, and electronic technology while assuring the accuracy and quality of the measurement. This paper provides some relevant experience for the benefit of others considering the installation of real time measurement systems. 8 figs.

50695 (CGA—8705, pp 26) **Primary device research.** Bell, D.G. (Nova Corp., Alberta). 1987. (CE—01895; CONF-8705317—).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

A better understanding of the effect on flow rate measurement of different operating parameters, station design, and equipment condition can result in reduced operating costs, more efficient meter station design, and improved metering accuracy. Using two orifice meter runs installed in series and high speed electronic data acquisition systems, it is possible to measure the change in metering which is introduced by some of these factors. These experiments are carried out using high pressure natural gas applications. Some of the conditions which have been studied are the presence of orifice plate nicks, gasket protrusions, incorrectly installed plates and liquid contamination. The results suggest that the current industry orifice plate rejection criteria could result in unnecessary plate rejections. Conversely, this work shows the centering of the plate to be extremely critical. Procedures may be necessary to ensure that appropriate centering tolerances are maintained. 3 refs., 8 figs.

50696 (CGA—8705, pp 148-153) **New electronic transfer prover.** Ensch, R. (Dresser Canada, Inc.). 1987. (CE—01895; CONF-8705317—).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

A greater emphasis on accurate gas measurement by gas utilities has enhanced the need for better methods of field testing gas meters. The transfer prover method is felt to be more accurate and repeatable than other field tests methods. The method only requires the input of temperature and pressure differences between the prover and the meter under test. This paper describes a typical transfer prover system using new electronic technolgy. Operational procedures outlined include powering up the console, self-checking, field meter connections, selecting the test parameters, and running the test. Automatic operation of the test ensures minimal human error. Accuracy and repeatability have been shown to be within 0.1% as compared to bell provers.

50697 **(CGA—8705) Measurement and energy management using new technology.** (Canadian Gas Association, Don Mills, Ontario). 1987. 555p. (CE—01895; CONF-8705317—). Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ont., Canada M3B 2R3; $8.00 CAN.

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

A conference of students of natural gas measurement was convened to examine new technology in the natural gas measurement field and its related activities. Papers were presented in the areas of gas meters, meter testing, measuring methods, electronic data acquisition, correction, and transmission, meter reading, analysis of gas energy content, gas processing plants, valves, and instrument design. Separate abstracts have been prepared for 33 papers from this conference.

50698 **(CV/GSL—1983) Analyses of stresses development in pipelines buried in freezing ground.** (Carleton Univ., Ottawa, Ontario (Canada). Geotechnical Science Labs.). [1983]. 61p. (CE—01833). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents an overview of the results of the second year of a study of stresses in a chilled pipeline buried in soils undergoing freezing and thawing conditions. The study is part of a joint Canada-France pipeline research project being undertaken in a large, temperature controlled facility in Caen, France. The main part of the report consists of a detailed presentation of selected data collected during the various experimental periods of the study. Work carried out during the contract year can be summarized as follows. The development of frost heave, the deformation of the pipe and the stresses produced within it has been detemined on a continuous basis over the length of the pipe during two periods of freezing and one period of thaw. Soil total stress, ground surface displacement, ground temperature and moisture parameters have been concurrently recorded at numerous points. Laboratory studies (in Canada) have provided information on the creep properties of the soils when frozen, on the frost heaving characteristics of the soils, and on their suction-water-content relationships. In addition to the calculations required to obtain the stess values, consideration has been given to the interrelation of the frost heave and creep of the frozen ground with the behaviour of the pipe. This problem, upon the solution of which the development of predictive models depends, has proved very complex. It is the main focus of current work, which also includes continuation of data collection during

progressive enlargement of the frozen ground annulus. 5 refs., 37 figs., 1 tab.

0330 Properties

50699 (CGA—8705, pp 9) **Optichrom microtech natural gas analyser.** Debusk, F. (Daniel Industries Canada). 1987. (CE—01895; CONF-8705317—).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

This paper has discussed the new silicon wafer gas chromatograph technology for natural gas measurements. This instrument is basically comprised of three high speed micro gas chromatographs that operate in parallel as a single unit. This instrument is designed specifically for determining the composition of natural gas from nitrogen to octane in less than two minutes. Using the gas composition, heating value and specific gravity of natural gas are calculated with an accuracy of less than 0.1% (1 BTU). The benefits of using this new analyzer technology are simple field installation, fast startup, easy operation, modular maintenance and extended analysis of gas through octane. 3 refs., 5 figs.

50700 **(PB—88-220066/XAB) Work on the origin of natural gas: global distribution and future supplies. Annual report, January 1, 1987-December 31, 1987.** Gold, T. (Gold (Thomas), Cambridge (UK)). Jun 1988. 22p. NTIS, PC A03/MF A01.

The global distribution of the occurrence of hydrocarbon deposits and associated gases and metals was studied further. The outgassing process of the noble gas helium and the strong association of helium with hydrocarbons implies that both have major contributions from deep levels. Gas measurements obtained during the drilling in Sweden at Siljan were analyzed. The major contributions of hydrogen, helium, methane, ethane, and pentane show strong correlations with each other and all these gases appear to have their origin in the formation. Gas values generally increased with depth down to the 6.5-km level reached so far. A magnetite oil sludge was discovered and its analysis shows it to be fine-grained magnetite together with oil and a group of specific biological molecules resembling closely those previously seen in the surface oil seeps of the region.

50701 **(PB—88-229984/XAB) Molecular theory and computer simulation studies of natural synthetic gas mixtures. Annual report, January-December 1987.** Gubbins, K.E. (Cornell Univ., Ithaca, NY (USA). School of Chemical Engineering). 31 Jan 1988. 41p. NTIS, PC A03/MF A01.

See also report for 1985, PB—86-203262.

The effect of molecular associations on the phase equilibria of fluids with multiple bonding sites is investigated. Initially, the individual molecules are represented by hard-sphere repulsive cores with off-center, square-well attractive sites. Such a system's thermodynamic properties can be calculated by using expressions based on a theory recently proposed by Wertheim. Isothermal-isobaric Monte Carlo simulations of hard-sphere fluids with one and two attractive sites are shown to be in good agreement with the results of the theory. The critical points and phase equilibria of the associating fluids are determined for various values of the strength and range of the attractive site. Furthermore, results are presented for the degree of association in the gas and liquid phases along the vapor-pressure curve. The theory can treat fluids with strong hydrogen-bonding associations such as the carboxylic acids, the aliphatic alcohols, hydrogen fluoride, water, etc.

0340 Combustion

REFER ALSO TO CITATION(S) 51931, 52082

50702 **(CRIE-T—87021) Characteristics of catalytic combustion of methane under pressurized atmospheres.** Fukuzawa, Hisashi; Ozawa, Yasushi; Oyama, Seiichi; Mandai, Shigemi; Inada, Mitsuru; Gora, Tetsuo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1987. 24p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754533/JAW.

As a part of the investigation and development project for catalytic combustion techniques, which are useful to reduce the generation amount of NOx in LNG combined cycle power plants, the catalytic combustion test of pressurized methane was conducted in consideration of the flow rate conditions of practical gas turbine combustors. The fundamental examination results of the combustion characteristics are as follows: The palladium catalysts presented a high activity at 500°C and 1.4 - 3.7 at in catalytic bed inlet and the catalytic combustion progressed stably to 100% in combustion efficiency. NOx was scarcely produced in the catalytic combustion process, and substantially no dependency of the NOx formation on the pressure was found. The catalytic bed pressure drop was about 1% at about 30 m/s in flow rate which corresponds to those of gas turbine combustors. The test result has revealed that the stable low NOx combustion of methane pressurized can be realized at the gas turbine combustor conditions. (13 figs, 1 tab)

50703 **(PB—88-230008/XAB) Development of a gas-fired vacuum furnace: an ion nitriding application, Phase 1. Final report, August 1986-March 1988.** Hemsath, K.H. (Indugas, Inc., Toledo, OH (USA)). Apr 1988. 114p. NTIS, PC A06/MF A01.

See also PB—88-130828.

In the project, a gas-fired vacuum furnace was designed, built and tested. The furnace design is based on a novel, patented heating concept that uses gas-fired burners. High velocity gases heat the surface of a round shell by impingement from the outside. The shell can be alternately heated and cooled, and is designed to sustain vacuum pressures. A novel vacuum door design maintains atmosphere integrity and allows use of a soft seal. Tests proved that the gas-fired vacuum furnace heats up very fast, allows very close temperature control, and can achieve exceptional temperature uniformity of furnace walls and furnace load. The furnace type is, therefore, ideally suited to find applications in an intermediary temperature range of about 500 to 1400°F. The furnace is now being prepared to operate as an ion nitrider. Ion nitriding is a case-hardening process, operates in a temperature range between 750 and 1050°F, and requires moderate vacuum.

0350 Storage

50704 **(CRIE—385052) Mechanical properties of cohesive soils.** Kataoka,Tetsuyuki; Ogata, Nobuhide. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jan 1987. 34p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770182/JAW.

As underground LNG tank stores LNG at -162°C in the sub-soil, frozen soil pressure and heaving displacement occurs if the surrounding soil around the tank is not heated. It may greatly influence the stability of the tank body if freezing is too much. The Central Research Institute of Electric Power Industry has carried out a series of research on the frost heaving mechanism around the subsoil LNG tank. This report briefly summarizes on the following items: Dynamic characteristics of the frozen subsoil necessary for calculating the time-wise change of the frozen soil pressure which reacts on the tank; monoaxial compression test and the past result of study were summarized for 13 kinds of viscous soil. 1) Monoaxial compression strength and deformation coefficient increases as temperature gets lower. The increasing rate gets slower and gets levelled at lower temperature. 2) The relation between these factors is not dependent on the type of sample, density, salt concentration, deposited ice, but is roughly proportional. (20 figs, 6 tabs, 16 refs)

04 OIL SHALES AND TAR SANDS

50705 **(ACHOOSD—87) Advisory Committee on Heavy Oil and Oil Sands Development fourth annual report, 1987.** (Advisory Committee on Heavy Oil and Oil Sands Development, Edmonton, Alberta (Canada)). 1987. 16p. (MICROLOG—88-03266). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Advisory Committee on Heavy Oil and Oil Sands Development was established by the Alberta Department of Energy and Natural Resources Amendment Act, 1983. The Committee was formed in recognition of the impact on communities by intense and accelerated growth from heavy oil and oil sands development. It monitors such growth and anticipates problems. The Committee advises the Government of Alberta on the need for, and scheduling of, implementation of government programs that provide public services and facilities in areas of the province affected by the development of heavy oil or oil sands resources. It provides a continuing liaison between the Government of Alberta and the communities that are or may be affected by the anticipated development of heavy oil or oil sands resources in their vicinity. The committee hears and reviews the concerns of residents regarding the possible effects of development on their communities and brings these concerns to the attention of the government. In general, the committee encourages and facilitates continuing communications among the organizations engaged in developing the heavy oil and oil sands resources, the residents of Alberta communities directly affected by that development, and the various provincial government departments and agencies concerned with the regulation of that development. This report outlines Alberta heavy oil/oil sands development activities over the past year and summarizes activities of the committee in the areas described above.

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 50720

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 50490, 50627, 50720, 50914

50706 **(BCU/CE—8709) Integrated retorting-combustion system using fluidized bed.** (British Columbia Univ., Vancouver (Canada). Dept. of Chemical Engineering). Sep 1987. 98p. (MICROLOG—88-03148). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

A successful 48 hour test run was carried out on a fluidized bed, retorting co-combustion pilot plant with pyrolysis of New Brunswick oil shale in the retort, and spent shale and Minto coal fuelling the combustor. Results of the test are presented. The primary purpose of the test was to determine the suitability of the apparatus, and thus no optimization or investigative program as indicated by the results was followed. The oil yield from the shale was 44% of the Fischer Assay evaluation. This is lower than previous studies have reported, and is probably due to cracking or re-deposition of oil on certain mineral species within spent shale that had a long residence time in the fluidized bed reactor. Sulphur capture was 45% in the combustor. This value was directly due to the small amounts of CaO in the spent shale fed to the combustion. The calculated Ca/S mol ratio was 0.52, and if this ratio was raised to unity or above the sulphur capture should increase. For a shale feed to the retort of 3.78 kg/h, and a coal feed to the combustor of 2.37 kg/h, the unit heat loss at 29,304 kJ/h amounted to about 41% of the heat input. The discharged flue gas contained about 39% of the heat input. For larger units than this test apparatus this amount should be higher, and about half of this lost heat could be recoverable as useful energy. 8 figs., 20 tabs.

50707 **(DOE/BC—88/1/SP) Handbook for personal computer versions enhanced oil recovery predictive models: Supporting technology for enhanced oil recovery.** Allison, E.; Waldrop, R.; Ray, R.M. (USDOE Bartlesville Energy Technology Center, OK). Feb 1988. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016750/JAW.

The personal computer (PC) programs described in this handbook were adapted from the Tertiary Oil Recovery Information System (TORIS) enhanced oil recovery (EOR) predictive models. The models, both those developed for the Department of Energy and those developed for the National Petroleum Council (NPC), were designed by Scientific Software-Intercomp and were used in the 1984 NPC study on the national potential for enhanced oil recovery. The Department of Energy, Bartlesville Project Office, supported the NPC study and has maintained the models since the study was completed. 10 refs.

50708 **(EMR/ER—4046/02/87) Upgrading of synthetic crude distillates with commercial hydrotreating catalysts. Final report.** (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario. Energy Research Labs.). Feb 1987. 158p. (MICROLOG—88-03132). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

With the objective of establishing an independent Canadian cabability in screening catalysts and synthetic crude feedstocks for hydrotreating applications, five commercial catalysts were tested using a partially upgraded gas oil feedstock in a bench scale hydroprocessing unit. Product qualities and yields were measured during the experimental program. Hydrogen consumption and the effects of various operating parameters were also determined. Each catalyst was tested in a screening phase at a variety of operating conditions for a minimum of 120 h (on-steam time). Product qualities were compared to determine the most effective catalyst, Shell S-424. This catalyst was then subjected to a long-term test (670 h) for further evaluation of its hydrotreating capabilities. The long-term test provided insufficient information regarding catalyst aging characteristics. Two gas oil products from the long-term test were then subjected to fluid catalytic cracking microactivity test unit to determine gasoline conversion characteristics. The gas oils converted to gasoline at greater levels than conventional gas oils. Another part of this report presents a design of a down-sized Canadian hydrotreating test center. It includes all the essential specifications required for future detailed implementation of such a facility. The overall conclusions and recommendations can be summarized as follows. Hydrotreatability of Canadian synthetic crude distillates with conventional, commercial catalysts has been proven, and Canadian hydrotreating expertise has also been established and enhanced. Design drawings, data and technical files are included in the appendices. 36 figs., 32 tabs.

50709 **(NSTU/M—8601) Upgrading Nova Scotia oil shale for potential uses.** Rockwell, M.C. (Nova Scotia Technical Univ., Halifax (Canada). Dept. of Mining and Metallurgical Engineering). Jan 1986. 104p. (MICROLOG—88-03138). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Oil shales in Nova Scotia are found at various locations on the mainland and on the island of Cape Breton. Two major oil shale deposits are located in Pictou and Antigonish Counties. The oil shales studied in this report are sampled from four exposed zones of the Pictou deposit. The shales are of a silicious nature and have an oil yield content ranging from 5.0 to 19.8 gal/ton, Fischer assay. The study reveals that the high grade oil shale of 19.8 gal/ton could be separated by screening techniques into fractions of oil yields ranging form 12 to 24 gal/ton. The higher yields could be used as a retort feed, whereas the lower yields could be used in thermal power generation or for further upgrading. The study concentrated in upgrading oil shale from a zone with 5.0 gal/ton by mineral processing techniqes. Five size fractions were tested using the Wilfley table, heavy liquid separation, conventional flotation and oil agglomeration/brine flotation. The fraction -600 + 150 microns responded positively to the heavy liquid separation and the fraction -45 microns to the oil agglomeration/brine flotation. This indicates a feasibility to initially upgrade or preconcentrate the shale at a coarser fraction prior to the treatment by flotation techniques. It was possible to obtain an oil yield exceeding 16 gal/ton (Fischer assay) by using an oil agglomeration/brine flotation technique. 29 refs., 17 figs., 20 tabs.

50710 (RAPAD—8501, pp 14-50) **Upgrading of tar sand bitumen and shale oil.** Sep 1985. Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and Development on Synfuels.

Tar sand bitumen is heavier than ordinary crude oil and contains large quantities of impurities including clay, sulfur, and heavy

metals. This study is aimed at developing process technologies by which good quality synthetic crude oil of low viscosity, low sulfur, and low metal content, may be obtained at high yields, and also establishing methods for the evaluation of the products derived from these processes. The processes being developed are: improved heat treatment process, solvent extraction process, and catalytic process. Shale oil is one of the most promising alternative liquid fuels, however since it contains much olefin, inorganic matter, metal, and nitrogen in comparison with ordinary crude oil, it is difficult to obtain upgraded products comparable to current petroleum products by applying the conventional petroleum refining technologies. Consequently, the objective of this study is to establish the technology of upgrading shale oil which will assure economical and stable operation, through the development of pretreating technologies such as demetalization, etc., hydrorefining technologies, high performance catalysts, and both fixed and ebullated bed reactors. Both of the above study reports introduce the relevant results in 1984. (36 figs, 16 tabs)

50711 (RAPAD—8502, pp 35-71) **Reforming and refining technology for oil sand oil, oil shale oil, etc. Processing technology for oil sand oil.** 1985. (In Japanese). Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and development of new fuel oil.

For the improvement of heat treatment process, oil sand oil (and the like) was subjected to thermal cracking, and the hydrogenated refined oil from the obtained gasoline fraction was reformed by catalyst. Hydrogenated refined oil from heavy fraction was subjected to fluidized catalytic cracking. Optimum conditions of hydro-viscosity breaking for a small pilot plant were established. The rate of removal of vanadium was 80% and desulfurization rate was 20%. The catalyst showed little deterioration in its activity even after 2,200 hour operation. In the field of solvent treatment process, selection of optimum conditions for the combined process of thermal cracking, solvent deasphalting and hydrogenation refining were studied, and the products obtained from the process was evaluated. A monograph was worked out for the estimation of thermal cracking rates. The synthasized catalyst proved to be superior in the reformation and refinement process. A new natural mineral catalyst with high yields of intermediate fractions was found which has good coke inhibition and abrasion resistant features. The system of the process was determined, and the first stage construction work of a 10BPD pilot plant was completed. (24 figs, 17 tabs)

50712 (RAPAD—8502, pp 72-89) **Reforming and refining téchnology for oil sand oil, oil shale oil, etc. Processing technology for oil shale oil.** 1985. (In Japanese). Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and development of new fuel oil.

For the ebullated bed treatment process, kerosene fraction which had the least allowable mixing rate in the second stage treatment was studied in 1984, with priority given to the treatment conditions and the stability of the treated oil. As the result, it was found that changes in the treatment conditions for kerosene fraction increased the allowable mixing rate of synthetic crude oil considerably. In addition, engineering study was made on the ebullated bed reactor. As regards fixed bed treatment process, long term life tests were made on the existing catalyst with high denitrification activity, and it was confirmed that high denitrification rate could be maintained by the use of the catalyst. Further, it was found that the denitrification reaction rate became higher when sulfur compounds were added, and that the effects varied according to the kinds of sulfur compounds. In addition, distributiion of arsenic which had been removed in the preceding hydrogenation arsenic removing treatment, and changes in hydrocarbon composition resulting from hydrogenation arsenic removal and denitrification treatment were studied. (18 figs, 3 tabs)

50713 (TCL—1988) **An investigation of the extraction of deactivating compounds from synthetic crudes with supercritical dioxide.** (Technitrol Canada Ltd., Pointe Claire, Quebec). 1988. 44p. (MICROLOG—88-03176). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Four heavy oils, Suncor coker kerosene, Syncrude coker naptha, Syncrude coker gas oil, and Suncor Coker gas oil, were extracted with supercritical carbon dioxide in an attempt to remove sulphur and nitrogen containing compounds. In all, 59 extractions were carried out under a variety of temperatures and pressures. The use of certain co-solvents such as water, methanol and acetic acid was investigated. Samples from each of the 59 runs were sumitted for microanalysis. It appears that there occurred little or no concentration of sulphur or nitrogen containing moieties in the supercritical gas extracts. Thus, although some fractionation of the heavy gas oil is possible, the dielectric constants of the sulphurous and nitrogeneous compounds closely resemble those of the hydrocarbons present making selective extraction impossible. No improvement in selectivity was observed when co-solvents such as water, methanol or acetic acid were present. It was concluded that supercritical carbon dioxide was unsuccessful as a solvent for the selective removal of sulphur and nitrogen containing compounds encountered in the four heavy gas oils. 20 refs., 3 figs., 11 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 50657

50714 (YU/CRESS—8802) **Study of the shock combustion of aromatic and napthenic hydrocarbons in jet fuels derived from the Canadian oil sands.** Britchard, H.O.; Nichols, R.W.; Cann, M.W.P. (York Univ., North York, Ontario (Canada). Centre for Research in Experimental Space Science). 15 Feb 1988. 63p. (MICROLOG—88-03150). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This paper addresses some of the problems arising from the aromatic and napthenic content of synthetic crudes from the Canadian oil sands, and the need to make them more acceptable for the production of diesel and jet fuels. A search of the literature was made to assess the present state of knowledge of the properties of polyaromatic hydrocarbons in respect of rates of ignition of mixtures with air, and rates of dehydrogenation during the early stages of the ignition and combustion processes. Relevant thermochemical calculations on these topics were also undertaken. An analysis was then made of the feasibility of an experimental study of these two problems by shock-tube methods, and the conditions required were defined. Detailed calculations are presented relating shock wave behavior and tube design. The shock-tube approach would require the use of the laser-based coherent anti-stokes Raman spectroscopy as a diagnostic tool. An alternative approach would be to perform experiments using a compression-ignition research facility or the very low pressure pyrolysis method. 70 refs., 2 figs., 9 tabs.

50715 **Nonlinear creep characteristics of Devonian oil shale.** Foust, S.H.; Chong, K.P.; Dana, G.F. (Dept. of Civil Engineering, Univ. of Wyoming, Laramie, WY (US)). pp 447-454 of Advances in rheology. Volume 4: Applications. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

Most studies concerning the mechanical characterization of oil shale to date have been done on material from the Green River Formation. The main purpose of this paper is to present results of a uniaxial creep study on Devonian oil shale, a material which differs considerably from the Green River Formation shale in appearance and composition. Constant stress creep tests were conducted, and the experimental data was modeled by a power function of time. A multiple integral form of nonlinear viscoelastic constitutive equation was utilized, and prediction curves were formulated based on the experimental data. Organic content, determined by Fisher Assay, was found to be an important parameter in the model. A prediction curve for two-step loading was formulated using a product form approximation of the kernel functions. The Devonian oil shale used in these tests was from the project hole designated ODOE Shawnee State Forest No. 1, Shawnee State Forest Headquarters, Friendship, Scioto County, Ohio.

0409 Waste Research And Management

50716 (ARC—8502, pp 115) **Composition of selected waste waters.** Gunter, W.D.; Regula, D. 15 Feb 1985. (CE—01873).

In Assessment of fluid-rock interaction, as related to subsurface waste disposal, in oil sands and heavy oil areas of Alberta and adjacent areas. Final report. Part 2.

Seven waste water samples from five separate oil sands steam pilots from the Athabasca study area were characterized by chemical analysis. The waters were dominantly of NaCl type. Silica, bicarbonate and sulfate were high. H/sub 2/S was prominent at two sites. Calcium and magnesium varied considerably. The dominant components of the non-volatile organic fraction were phenols. pH varied from 6.8 to 9.0. Comparison with published analyses of produced waters from other steam pilots indicate that the analyses reported here are representative. Calculations were done using the computer program SOLMNEQ to compare these waste water analyses to the formation waters encountered in two aquifers. Amorphous silica was predicted to precipitate from the waste waters and may create a problem in the aquifer. 4 refs., 24 figs., 12 tabs.

50717 (ARC—8502, pp 77) **Partitioning of phenol in simulated fluid injection zones using C-14 as a tracer.** Wallick, E.I.; Huemmert, H.R. 15 Feb 1985. (CE—01873).

In Assessment of fluid-rock interaction, as related to subsurface waste disposal, in oil sands and heavy oil areas of Alberta and adjacent areas. Final report. Part 2.

The partitioning of an organic compound that is found in waste water produced at oil sands processing plants was studied by means of a controlled laboratory experiment. Carbon-14 labelled phenol was introduced into sediment-water systems consisting of synthetic formation water and actual formation materials in an atmosphere of argon and 9:1 and 8:2 mixtures of argon and CO/sub 2/ to simulate a deep aquifer environment. Samples of the suspension were sampled daily over a seventeen day period. The carbon-14 activity was determined in water, toluene-extracted organic matter, and in sediments. Results of the experiment showed that little difference in the amount of activity could be found in the water and organic fractions but that the sediments from the Beaverhill Lake Formation adsorbed about an order of magnitude more activity than the McMurray Formation samples. Trends of uptake and loss of carbon-14 activity by the various phases were both present and easily measured. The observations suggest that sorption may be only temporary and that retardation factors may vary with time. Further study of the fate of organic matter in simulated deep aquifer systems is recommended. The physical-chemical basis for the uptake of carbon-14 by water and the differential adsorption of activity by the carbonate sediment as compared with the organic-rich oil sand would be valuable in contributing to knowledge of organic-inorganic chemical interaction. Further study of the kinetics of the systems and perhaps attempts at relating the rates to field conditions by ratios of laboratory and field specific surface area would contribute to estimation of retardation factors and planning of possible in situ field tests. 5 refs., 21 figs., 39 tabs.

50718 (ARC—8502, pp 41) **Selected bibliography on fluid injection.** Hitchon, B.; Lytriak, A.T. 15 Feb 1985. (CE—01873).

In Assessment of fluid-rock interaction, as related to subsurface waste disposal, in oil sands and heavy oil areas of Alberta and adjacent areas. Final report. Part 2.

A bibliography is presented of 172 entries on various aspects of fluid injection as a means of underground disposal of oil sand/heavy oil waste water. Emphasis is upon Canadian and US sources. Author and keyword indexes are included.

50719 **(ARC—8502) Assessment of fluid-rock interaction, as related to subsurface waste disposal, in oil sands and heavy oil areas of Alberta and adjacent areas. Final report. Part 2.** Hitchon, B. (Alberta Research Council, Edmonton (Canada)). 15 Feb 1985. 242p. (CE—01873). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report presents laboratory and field studies on aspects of fluid injection as related to the disposal of waste water in oil sands and heavy oil operations. Attention is paid to Alberta oil sand deposits and to the characterization and the fluid-formation interactions of the waste water. A bibliography is also included. Separate abstracts have been prepared for three papers from this report.

0420 Regulations

50720 **(ERCB/C—D88-12) Other six leases operation application to construct a dredging/cold water extraction experimental field test. Decision D88-12.** (Energy Resources Conservation Board, Calgary, Alberta (Canada)). 12 Jul 1988. 8p. (CE—01843). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $5.00 CAN.

A hearing was conducted with respect to an application for approval to conduct a small, simulated dredging/cold water extraction experimental field test in the Fort McMurray area of Alberta. The details of project operation, potential environmental impacts, and plans to reclaim the site were addressed. One intervenor in the hearings claimed the test would duplicate another recently approved test and would therefore not be in the public interest. The applicant stated that its objective was to test a unique cold-water process and that the only thing in common with the other test was the mining equipment used. Because the applicant was willing to restrict its activities to those proposed in its application, the application was approved without addressing the test duplication question. 1 fig.

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 52449, 52461

50721 (PER—148, pp 5-6) **Uranium distribution in greisens from archaean granites in the vicinity of the Klerksdorp Goldfield.** Robb, L.J.; Meyer, M. (University of the Witwatersrand, Johannesburg (South Africa). Economic Geology Research Unit). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50722 (PER—148, pp 7-8) **Uranium distribution in the hinterland of the East rand and Evander Goldfields.** Ferraz, M.F.; Robb, L.J. (University of the Witwatersrand, Johannesburg (South Africa). Economic Geology Research Unit). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50723 (PER—148, pp 11-12) **Uranium and thorium distribution in late-stage granite plutons from the Barberton mountain land.** Meyer, M.; Robb, L.J.; Anhaeusser, C.R. (University of the Witwatersrand, Johannesburg (South Africa). Economic Geology Research Unit). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50724 (PER—148, pp 14) **Anorthosite-related polymetallic thorium-uranium deposits in the Namaqualand Metamorphic Complex, South Africa.** Andreoli, M.A.G.; Andersen, N.J.B.; Faurie, J.N. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50725 (PER—148, pp 18-19) **Uranium, thorium and potassium distribution in granitoid rocks from selected areas of the Natal Structural and Metamorphic Province.** Kerr, A.; Eglington, B.M.; Botes, Z.A. (Natal Univ., Durban (South Africa); Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.; Department of Mineral and Energy Affairs, Pretoria (South Africa). Geological Survey). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50726 (PER—148, pp 31-32) **Radioelement behaviour during in situ kaolinization and weathering of selected Cape granites.** Scheepers, R. (Stellenbosch Univ. (South Africa)). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50727 (PER—148, pp 35-36) **Uranium mineralogy of the Beisa Reef - an introduction to the nature of the Hinterland to the Welkom Goldfield.** Drennan, G.R.; Robb, L.J. (University of the Witwatersrand, Johannesburg (South Africa). Economic Geology Research Unit). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50728 (PER—148, pp 43-44) **Interpretation and evaluation of regional geochemical anomalies of uranium.** Frick, C.; Strauss, S.W. (Department of Mineral and Energy Affairs, Pretoria (South Africa). Geological Survey). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

50729 (PER—148, pp 39-42) **Permeability of sediments and its application for uranium mineralization in the Karoo sequence.** Le Roux, J.P. (Stellenbosch Univ. (South Africa)). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

In the main Karoo Basin of South Africa, uranium mineralization seems to have been controlled by two main factors, namely the permeability of the sandstones and the distribution of organic matter. If the sedimentological controls of these factors can be established, it may lead to a firmer foundation for uranium exploration, as predictions may be made regarding the sub-environments most favourable for mineralization. During 1984, the Atomic Energy Corporation decided to study these aspects in the laboratory, using the existing facilities of the National Research Institute for Oceanology at Stellenbosch.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 51238, 51776, 51835, 52657, 52671, 52672, 52675

50730 (ANL/RERTR/TM—9) **Reduced enrichment for research and test reactors: Proceedings.** (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 536p. (CONF-861185—). NTIS, PC A23. Order Number DE88012713/JAW.

From Reduced Enrichment for Research and Test Reactors (RERTR) program international meeting; Gatlinburg, TN, USA (3 Nov 1986).

The international effort to develop new research reactor fuel materials and designs based on the use of low-enriched uranium, instead of highly-enriched uranium, has made much progress during the eight years since its inception. To foster direct communication and exchange of ideas among the specialist in this area, the Reduced Enrichment Research and Test Reactor (RERTR) Program, at the Argonne National Laboratory, sponsored this meeting as the ninth of a series which began in 1978. All previous meetings of this series are listed on the facing page. The focus of this meeting was on the LEU fuel demonstration which was in progress at the Oak Ridge Research (ORR) reactor, not far from where the meeting was held. The visit to the ORR, where a silicide LEU fuel with 4.8 g A/cm³ was by then in routine use, illustrated how far work has progressed.

50731 (DP-MS—87-177) **Instrumentation for criticality safety control in a fuel fabrication facility.** Honkonen, D.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 44p. (CONF-880601—40). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013355/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Many different forms of enriched uranium-aluminum alloy components and waste are generated in the fuel fabrication facility at SRP. Accordingly, a variety of different instruments are used to help prevent accidental criticality with these materials. This paper describes some these instruments and some novel uses to which they are put.

50732 (FMPC—2149) **A criticality alarm system for a uranium metal production facility.** D'Aquila, D.M. (Westinghouse Materials Co., Fernald, OH (USA)). 1988. Contract AC05-86OR21600. 13p. (CONF-8806175—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013762/JAW.

From People to people delegation to the Peoples Republic of China; Beijing, China (15 Jun 1988).

Even though the prevention of a criticality accident through engineered and administrative controls is of foremost importance at a non-reactor fuel production facility, there is always some residual risk of a criticality accident. Criticality alarm systems are provided for non-reactor nuclear facilities in areas where fissle material is processed or stored. Regulatory guidance is provided in the American National Standard Institute 8.3, "Criticality Alarm System". The application of this standard for a low enriched uranium metal fuel production facility will be discussed.

50733 (K/PS—1185) **UF_5 production for transport studies.** Jarabek, R.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 20 Feb 1986. Contract AC05-84OT21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016252/JAW.

Uranium pentafluoride has been produced successfully in two attempts by a method originated in this laboratory, UF_6 was reacted with (1) a mixture of U_2F_9, iron, and FeF/sub x/ (part of the reaction products from a previous attempt) and (2) iron filings. Both attempts produced sizable quantities of α-UF_5, the latter estimated at approximately 8 g. The formation of either α- or β-UF_5 depends upon temperature of reaction. Beta- UF_5 is formed in low temperature (less than 125{degree}C) reactions while α-UF_5 is formed in high temperature (greater than 150{degree}C) reactions. The two forms differ in the physical properties of color and density. Alpha-UF_5 is denser than β-UF_5 which is currently being prepared in room temperature reactions. Beta-UF_5 is extremely light and fluffy, which makes it difficult to handle. (Static electricity in a drybox blows the β-UF_5 around which makes the β-UF_5 difficult to contain in a vial.) Alpha-UF_5 has been found to be easy to handle. The differences in the color of the two forms is an area of much discrepancy and is reviewed in the discussion section of this report. Differences are also present in x-ray patterns and infrared and Raman spectra and will be reviewed in a future publication. 10 refs., 1 fig., 6 tabs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 50746, 50814, 50852, 50853, 50854, 50855, 50859, 50864, 51152, 51201, 51864, 52026

50734 **(CEA-CONF—9331) Marcoule pilot reprocessing plant construction and starting up.** Le Bouhelec; Fabre; Farrugia; Revol; Patarin. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 6p. (CONF-870917—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754776/JAW.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

In this paper the author gives the history of the Marcoule pilot plant, the new conception and construction and the tests carried in view of restarting the plant.

50735 **(DOE/EH—0065) Technical Safety Appraisal of the Plutonium Finishing Plant, Westinghouse Hanford Company.** Brinkerhoff, L.C. (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety). Apr 1988. 232p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88010962/JAW.

The Plutonium Finishing Plant (PFP) is located in the 200 West Area of the Hanford Site in Southeastern Washington State. The PFP is operated for RL by the Westinghouse Hanford Company (WHC). Program direction is provided by DOE's Assistant Secretary for Defense Programs, Office of Nuclear Materials. Sixty-eight concerns are contained in this report which pertain to achieving compliance with some aspect of a DOE requirement or to achieving a greater level of safety. None of these concerns address a situation that presents a "clear and present danger" or requires expedited attention by the contractor. Thus, all are categorized as Category III for seriousness. Each concern has been characterized by relative hazard and compliance considerations. The results are indicated to the left of each concern by an alphanumerical designation giving the assigned relative hazard level (H) and compliance level (C) (e.g., H2/C3). These characterization are also summarized in Part 1 of Appendix B to this report. The concerns are tabulated in Part 2 of Appendix B. The reader is cautioned that to understand the full intent of any concern, it is necessary also to read its supporting bases, which are found in Section III of the report. A total of 90 Performance Objectives in 13 subject areas have been addressed by this appraisal. Concerns associated with 42 of these Performance Objectives have been developed.

50736 **(DOE/EH—0068) Technical Safety Appraisal of the PUREX [Plutonium Uranium Extraction Plant] Reprocessing Facility, Westinghouse Hanford Company.** Schleiter, T.G. (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety). Apr 1988. 253p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88013412/JAW.

Five of the concerns contained in this report were judged to be of Category II seriousness, i.e., they addressed hazards of sufficient significance to warrant expedited attention by the contractor. Four of these, which deal with radiation protection and contamination control, were being addressed by the contractor while the appraisal team was still in the field. The other concern requiring expedited attention deals with improvement of the fire protection program. Interim or final actions to eliminate all of these concerns and to reduce the likelihood of their recurrence were taken promptly by the contractor and, as necessary, long-term remedial actions to correct underlying problems are being actively studied and pursued. A considerable number of deficiencies were found that require the attention of the contractor. In evaluating these deficiencies for common factors, the Office of the Deputy Assistant Secretary for Safety, Health and Quality Assurance (EH) has identified six major areas of concern: radiological protection and fire protection programs, document control, configuration control, quality assurance, and the transition effects of contractor consolidation at Hanford.

50737 **(DOE/ID/12651—2-Rev.A) PCDP [Prototypical Spent Fuel Consolidation Equipment Demonstration Project] design basis accident report 9315-P-103, Rev. A.** (NUS Corp., Gaithersburg, MD (USA)). Dec 1987. Contract AC07-86ID12651. 43p. NTIS, PC A04. Order Number DE88015041/JAW.

The Department of Energy's Office of Civilian Radioactive Waste Management (OCRWM) has identified a requirement to integrate the spent fuel rod consolidation design activities of each of several proposed geological repository facilities and the Monitored Retrievable Storage (MRS) facility, and to develop efficient and cost-effective equipment for the consolidation process. The equipment to be developed for the rod consolidation system will be required to operate in a dry environment at rates which can be appropriately scaled to approximate the waste management system acceptance rates, irrespective of repository geologic characteristics or the existence of an MRS facility in the waste management system. The purpose of this report is to identify and analyze the range of facility credible events and accident occurrences (from minor to the design basis accidents) and their causes and consequences. For each situation, the considerations to prevent or mitigate the event or accident is addressed.

50738 **(DOE/ID/12651—2-Vol.1) Fuel Rod Consolidation Project: Phase 2, Final report: Volume 1.** (NUS Corp., Gaithersburg, MD (USA)). 21 Dec 1987. Contract AC07-86ID12651. 446p. NTIS, PC A19/MF A01; 1; GPO Dep. Order Number DE88004219/JAW.

This design report describes the NUS final design of the Prototype Spent Nuclear Fuel Rod Consolidation System. This summary presents the approach and the subsequent sections describe, in detail, the final design. Detailed data, drawings, and the design Basis Accident Report are provided in Volumes II thru V. The design as presented, represents one cell of a multicell facility for the dry consolidation of any type of PWR and BWR fuel used in the United States LWR industry that will exceed 1% of the fuel inventory at the year 2000. The system contains the automatically-controlled equipment required to consolidate 750MT (heavy metal)/year, at 75% availability. The equipment is designed as replaceable components using state-of-the-art tchnology. The control system utilizes the most advanced commercially available equipment on the market today. Two state-of-the-art advanced servo manipulators are provided for system maintenance. In general the equipment is designed utilizing fabricated and commercial components. For example, the main drive systems use commercially available roller screws. These rollers screws have 60,000 hours of operation in nuclear power plants and have been used extensively in other applications. The motors selected represent the most advanced designed servo motors on the market today for the precision control of machinery. In areas where precise positioning was not required, less expensive TRW Globe motors were selected. These are small compact motors with a long history of operations in radiation environments. The Robotic Bridge Transporters are modified versions of existing bridge cranes for remote automatic operations. Other equipment such as the welder for fuel canister closure operations is a commercially available product with an operating history applicable to this process. In general, this approach was followed throughout the design of all the equipment and will enable the system to be developed without costly development programs.

50739 **(DOE/ID/12651—2-Vol.2) Fuel Rod Consolidation Project: Phase 2, Final report: Volume 2, Appendices.** (NUS Corp., Gaithersburg, MD (USA)). 21 Dec 1987. Contract AC07-86ID12651. 453p. NTIS, PC A20. Order Number DE88004220/JAW.

This document, Volume 2, provides the appendices to Volume 1 of the Fuel Rod Consolidation Project. It provides information on the following: References; Trade-off Studies; Instrument List; RAM Data; Fabrication Specifications; Software Specifications; and Design Requirements.

50740 (KURRI-TR—294, pp 62-68) **Criticality safety of solvent extraction process.** Tachimori, Shoichi; Miyoshi, Yoshinori. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

The article presents some comments on criticality safety of solvent extraction processes. When used as an extracting medium, tributyl phosphate extracts nitric acid and water, in addition to nitrates of U and Pu, into the organic phase. The amount of these chemical species extracted into the organic phase is dependent on and restricted by the concentrations of tributyl phosphate and other components. For criticality control, measures are taken to decrease the concentration of tributyl phosphate in the organic phase, in addition to control of the U and Pu concentrations in the feed water phase. It should be remembered that complexes of tributyl phosphate with nitrates of such metals as Pu(IV), Pu(VI), U(IV) and Th(IV) do not dissolve uniformly in the organic phase. In criticality calculation for solution-handling systems, U and Pu are generally assumed to have a valence of 6 and 4, respectively. In the reprocessing extraction process, however, U and Pu can have a valence of 4, and 3 and 6, respectively. The organic phase and aqueous phase contact in a counter-current flow. U and Pu will be accumulated if they are not brought out of the extraction system by this flow. (Nogami, K.).

50741 **(PB—88-226873/XAB) Development of liquid-fed ceramic melter (LFCM) for commercial scale vitrification.** Sakai, A.; Asano, H.; Murakoshi, T.; Saiga, H. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01.

Included in IHI (Ishikawajima-Harima Heavy Industries) Engineering Review, Vol. 28, No. 2, 87-92(Mar 1988).

Some precipitates of noble metals are expected to be generated in the melting cavity during the commercial vitrification of high-burnup-fuel reprocessing. Thus the liquid-fed ceramic melter (LFCM) should be designed with a sloped floor with bottom sump which allows the precipitated metal to be removed by a bottom drain. The paper describes the development and evaluation of a three-electrode pilot-scale LFCM for the effect of bottom-electrode power supply on the concentration of noble metals and the larger glass inventory for the commercial scale LFCM and for its ability to drain out conductive bottom sludges.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 50803, 50858

50742 (CONF-760202—, pp 679-684) **Burial of a high activity waste evaporator tube bundle.** Ratchford, D.J. (E. I. du Pont de Nemours and Company, Inc., Aiken, SC (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Transport of a large and highly radioactive piece of failed separations equipment from process building to storage area was achieved with minimum personnel exposure through detailed preplanning by all groups concerned. Plans were developed for remote unloading, use of a sacrificial transport box, use of spacer railroad cars, off-shift movement, extra crane shielding, and radio communications. The entire operation was pretested by a dry run.

50743 (KURRI-TR—294, pp 69-76) **Criticality safety in nuclear material transport.** Nakagome, Yoshihiro. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

In the nuclear fuel cycle of the conversion, enrichment, reconversion, fabrication, use and reprocessing, the transportation of nuclear fuel substances between those establishments necessarily accompanies. Also between universities and research institutes, the nuclear fuel substances used for research and experiment are sometimes transported, though the quantity is small. The transportation is classified into three modes by land, sea and air. Therefore, the possibility of traffic accidents is added to the potential risk of nuclear fuel substances. The safety at the time of transporting nuclear fuel substances is strictly demanded against the leak of radioactive substances, radiation exposure and criticality accidents. As to the safety standard regarding the transportation of radioactive substances, there is the 'Regulations for the Safe Transport of Radioactive Materials', which was published by the IAEA, and has been recommended to be adopted in various countries and organizations. Also in Japan, the relevant laws regulate the transportation of radioactive substances. As to criticality safety, the quantity of contents is limited, and the number and arrangement of transported casks are controlled so that criticality never occurs during transport. The criticality safety analysis for transported nuclear fuel is described. (Kako, I.).

50744 **(PNL-SA—15457) Criticality experiments with units of LWR-type fuel rods submerged in water and separated by neutron flux traps.** Bierman, S.R. (Pacific Northwest Lab., Richland, WA (USA)). 1988. Contract AC06-76RL01830. 3p. (CONF-880601—46). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014908/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

A series of criticality experiments to provide benchmark-type data on neutron flux traps has been completed at the US Department of Energy Hanford Critical Mass Laboratory, operated by the Pacific Northwest Laboratories of Battelle Memorial Institute. The experiments were funded by the Sandia National Laboratory, and are designed to simulate transport environments and high-density fuel storage facilities. the experimental assemblies consisted of 2 {times} 2 arrays of 4.31 wt% ^{235}U-enriched UO_2 fuel rods arranged in water on a 1.891-cm² center-to-center spacing. This lattice spacing results in a moderator-to-fuel volume ratio of 1.6 which approximates that found typically in boiling water reactors and in pressurized water reactors. Each assembly consisted of four, near equally sized units of fuel rods separated by a neutron flux trap and varying amounts of moderator. 4 refs., 2 tabs.

50745 **KENO V.a validation of fuel pin experiments.** Dyer, H.R.; Westfall, R.M. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 382-385(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The results of computations performed on a set of critical experiments designed to simulate high-density storage of reactor fuel pins are described. The purpose of these computations is to validate the Monte Carlo criticality code KENO V.a with the four cross-section libraries provided with the SCALE modular code system. A series of 21 critical experiments, performed by the Babcock & Wilcox Company to simulate close-packed fuel pin storage, was modeled. The CSAS4 control module within SCALE was used to calculate the effective neutron multiplication factor (k/sub eff/) via the KENO V.a criticality code. The experiments consisted of 5 x 5 arrays of fuel pin modules each ~ 19-cm square.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 50803

50746 **(DOE/ID/12651—2-Vol.4) [Fuel Rod Consolidation Project]: The estimated total life cycle cost for the 30-year operation of prototypical consolidation demonstration equipment: Volume 4, Phase 2.** (Johnson (E.R.) Associates, Inc., Reston, VA (USA)). 22 Dec 1987. Contract AC07-86ID12651. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004222/JAW.

The Total Life Cycle Costs have been developed for the construction, operation and decommissioning of a single line of hot-cell-enclosed production consolidation equipment operating on spent fuel at the rate of 750 MTU/year for 30 years. The cost esti-

mate is for a single production line that is part of an overall facility at either a Monitored Retrievable Storage or a Repository facility. This overall facility would include other capabilities and possibly other consolidation lines. However, no costs were included in the cost estimate for other portions of the plant, except that staff costs include an overhead charge that reflects the overhead support services in an overall facility.

0520 Waste Management

REFER ALSO TO CITATION(S) 51212, 51380, 51403, 51691, 51746, 52158, 52166, 52900

50747 **(AERE-G—4440) Investigation of Durasil absorbers for the removal of radionuclides from aqueous solutions.** Cross, J.E.; Hooper, E.W. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). May 1988. 45p. (DOE-RW—88.011). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754521/JAW.

Inorganic ion-exchange materials supplied by the Duratek Corporation, Maryland, USA have been tested in batch contact experiments to assess their effectiveness in removing radionuclides from aqueous solutions. The three absorbers tested, D10, D70 and D190, showed an affinity for all fourteen radionuclides present in the test solutions.

50748 **(AERE-G—4533) Electrochemical ion-exchange for medium active liquid waste treatment. Progress report 1987.** Turner, A.D.; Bridger, N.J.; Junkison, A.R. (UKAEA Harwell Lab. Materials Development Div.; Department of the Environment, London (UK)). Jan 1988. 5p. (DOE-RW—88.037). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754522/JAW.

A non-active 0.1 m/sup 3//h electrochemical ion-exchange (EIX) treatment plant has been successfully commissioned using 0.2 x 1 m electrodes fabricated from mixed Amberlite CG50/IRC84 by a mould route. At 50% design throughout, DFs of 20,000 were observed - falling to 2000 at 75%. At 0.1 m/sup 3//h, the DF was {similar←to} 200, though this decrease could have partly been caused by electrode deformation after 38h operation. Cell modification will prevent this in future. Small-scale tests have shown zirconium phosphate (ZrP) to have excellent EIX properties below pH 12, although above this hydrolysis occurs. However, under the polarity reversal conditions used for selectivity enhancement, this problem is negligible. An active 0.1 m/sup 3//h plant has now been built in the site effluent treatment centre to test ZrP electrodes for the treatment of active waste streams. A high capacity EIX system for plutonium removal has yet to be demonstrated. However, as a DF of 2 was observed at pH 1.5, followed by desorption on polarity reversal, there are indications that ZrP may be effective at pH $>$ 4. Some adsorption has also been observed onto a high surface area Ti electrode at pH 3 (corresponding to 2.7 kBq/cm/sup 3/), followed by complete desorption into 1M HNO/sub 3/ on polarity reversal. Improved performance is expected with further development.

50749 **(BMI/ONWI—223) Geochemistry and petrology of surface samples, six boreholes and brines from the Salton Sea geothermal field: A natural analog of a nuclear waste repository in salt: Report No. 3.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). May 1987. Contract AC02-87CH10290;AC06-76RL01830;AC02-83CH10140. 273p. (UCR/IGPP—87/4). H. Order Number TI88016597/JAW.

Cuttings from six wells in the Salton Sea geothermal field, and rocks at outcrop that are correlative in age with those encountered at depth in the wells were analyzed in detail. Mineralogy, petrography, x-ray diffraction, electron microprobe, instrumental neutron activation analysis, fission track radiography, oxygen and stable carbon isotopic, uranium-thorium series disequilibrium, and fluid inclusion analyses are reported. Where fluids were being produced from wells, brine chemistry as well as stable isotope and uranium-thorium series analyses are reported. Particular attention has been paid to defining zones of fluid-rock interaction in which analyses of coexisting geothermal reservoir brine and hydrothermally altered sediments could be acquired. A wide span of temperatures, from surficial to greater than 300{degree}C, and salinities ranging from relatively dilute ground waters up to brines of 25 wt% total dissolved solids, span a range of environments that might be encountered in a waste repository in salt. Progressive hydrothermal alteration, mineral formation and element mobility are documented in the data presented. 52 refs., 25 figs., 49 tabs.

50750 **(BMI/ONWI/C—99(4)) Technical procedures for water resources: Volume 4, Deaf Smith County site, Texas: Environmental Field Program: Final draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Morrison-Knudsen Engineers, Inc., Denver, CO (USA)). Aug 1987. Contract AC02-87CH10290;AC02-83CH10140. 298p. H. Order Number DE88014277/JAW.

This volume contains Technical Procedures pursuant to the water Resources Site Study Plan: including Collection, Preservation, and Shipment of Ground-Water Samples; Inventory Current Water Use and Estimating Projected Water Use; Estimation of Precipitation Depth, Duration, Frequence; Estimation of Probable Maximum Precipitation; Calculation of Floodplains.

50751 **(BMI/ONWI/C—120) Environmental regulatory compliance plan, Deaf County site, Texas: Draft revision 1.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 14 Dec 1987. Contract AC02-87CH10290. 183p. H. Order Number TI88016590/JAW.

The DOE is committed to conduct its operation in an environmentally safe and sound manner and comply with the letter and spirit of applicable environmental statues and regulations. These objectives are codified in DOE order N 5400.2, "Environmental Policy Statement." This document, the Deaf Smith County site (Texas) Environmental Regulatory Compliance Plam (ERCP), is one means of implementing that policy. The ERCP describes the environmental regulatory requirements applicable to the Deaf Smith County site (Texas), and presented the framework within which the Salt Repository Project Office (SRPO) will comply with the requirements. The plan also discusses how DOE will address State and local environmental requirements. To achieve this purpose the ERCP will be developed in phases. This version of the ERCP is the first phase in the delopment of the ERCP. It represents the Salt Repository Project Office's understanding of environmental requirements for the site characterization phase of repository development. After consultation with the appropriate federal and state agencies and affected Indian tribes, the ERCP will be updated to reflect the results of consultation with these agencies and affected Indian tribes. 6 refs., 38 figs.

50752 **(BMI/ONWI/C—162) Validation of TEMP: A finite line heat transfer code for geologic repositories for nuclear waste.** Atterbury, W.G.; Hetteburg, J.R.; Wurm, K.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Battelle Columbus Div., OH (USA)). Sep 1987. Contract AC02-87CH10290;AC02-83CH10140. 108p. H. Order Number TI88016504/JAW.

TEMP is a FORTRAN computer code for calculating temperatures in a geologic repository for nuclear waste. A previous report discusses the structure, usage, verification, and benchmarking of TEMP V1.0 (Wurm et al., 1987). This report discusses modifications to the program in the development of TEMP V1.1 and documents the validation of TEMP. The development of TEMP V1.1 from TEMP V1.0 consisted of two major efforts. The first was to recode several of the subroutines to improve logic flow and to allow for geometry-independent temperature calculation routines which, in turn, allowed for the addition of the geometry-independent validation option. The validation option provides TEMP with the ability to model any geometry of temperature sources with any step-wise heat release rate. This capability allows TEMP to model the geometry and heat release characteristics of the validation problems. The validation of TEMP V1.1 consists of the comparison of TEMP to three in-ground heater tests. The three tests chosen were Avery Island, Louisiana, Site A; Avery Island, Louisiana, Site C; and Asse Mine, Federal Republic of Germany, Site 2. TEMP shows marginal comparison with the two Avery Island sites and good comparison with the Asse Mine Site. 8 refs., 25 figs., 14 tabs.

50753 (BMI/ONWI/C—164) Sandstone distribution and lithofacies of the Triassic Dockum Group, Palo Duro Basin, Texas: Final report. Johns, D.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Texas Univ., Austin (USA). Bureau of Economic Geology). 1988. Contract AC02-87CH10290;AC97-83WM46651. 100p. H. Order Number TI88016608/JAW.

The Triassic Dockum Group in the Palo Duro Basin consists of many interbedded sequences of coarse- to fine-grained terrigenous clastic sedimentary strata. Four sandstone-dominated progradational sequences appear in the lower Dockum section. Sandstone in the first unit has a relatively uniform distribution across the basin, owing to deposition by broad alluvial fans and fan deltas. Sandstones in the remaining units and the upper Dockum are unevenly distributed owing to deposition by deltaic and fluvial systems. Sediment sources for Triassic strata in the Palo Duro Basin, according to net-sandstone trends, indicate deposition from the west, north, and east for the basal unit, dominantly from the east for units 2 and 3, and mixed western and eastern sources for unit 4 and the upper Dockum. Net-sandstone distribution patterns and lithofacies trends suggest proximal depositional environments in the present eastern and northeastern Dockum and more distal environments to the west and southwest. Paleodip was apparently from east to west over most of the Texas side of the basin, possibly changing in the area of the Texas-New Mexico border. Basement structural elements within the basin were subtly active during deposition and influenced the local accumulation of sandstone. 38 refs., 25 figs., 3 tabs.

50754 (BMI/ONWI/C—167) Environmental monitoring and mitigation plan for site characterization: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; USDOE Salt Repository Project Office, Hereford, TX). Jan 1988. Contract AC02-87CH10290. 153p. H. Order Number TI88016601/JAW.

The purpose of the EMMP is: to identify, in consultation with the affected states and Indian tribes, potentially significant adverse environmental impacts that could result from site characterization activities, to describe data collection methods that will be used to monitor any such identified impacts, and procedures for mitigating them. Chapter 2 of the EMMP provides an overview of the background and scope of the document. Chapter 3 of the EMMP provides a description of site characterization phase activities planned to assess the geologic condition of the site and construct the exploratory shafts and surface support facilities. The rationale for developing environmental monitoring studies is presented in Chapeter 4. Chapter 5 contains descriptions of the environmental monitoring and mitigation procedures whenever they are applicable. Additionally, in Chapter 6, the EMMP includes a procedure for modifying the monitoring and mitigation program and an approach for reporting monitoring results to interested parties. 21 figs., 10 tabs.

50755 (BMI/ONWI/C—168) Site study plan for non-routine laboratory rock mechanics, Deaf Smith County Site, Texas: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1987. Contract AC02-87CH10290. 92p. H. Order Number TI88016508/JAW.

This Site Study Plan describes the non-routine rock mechanics and thermal properties laboratory testing program planned for the characterization of site-specific geologic materials for the Deaf Smith County site, Texas. The study design provides for measurements of index, mechanical, thermomechanical, thermal and special properties for the host salt, and where appropriate, for nonhost lithologies. The types of tests which will be conducted are constant stress (creep) tests, constant strain (stress relaxation) tests, constant strain-rate tests, constant stress-rate tests, cyclic loading tests, hollow cylinder tests, uniaxial and triaxial compression tests, direct tension tests, indirect (triaxial) shear tests, thermal property determinations (conductivity, specific heat, expansivity, and diffusivity), fracture healing tests, thermal decrepitation tests, moisture content determinations, and petrographic and micromechanics analyses. Tests will be conducted at confining pressures up to 30 MPa and temperatures up to 300{degree}C. These data are used to construct mathematical models for the phenomenology of salt deformation. The models are then used in finite-element codes to predict repository response. A tentative testing schedule and milestone log are given. The duration of the testing program is expected to be approximately 5 years. 44 refs., 13 figs., 13 tabs.

50756 (BMI/ONWI/C—169) Underground layout trade-off study. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stearns Catalytic Corp., Denver, CO (USA)). 1988. Contract AC02-87CH10290. 112p. H. Order Number TI88016505/JAW.

This report presents the results of a technical and economic comparative study of four alternative underground layouts for a nuclear waste geologic repository in salt. The four alternatives considered in this study are (1) separate areas for spent fuel (SF) and commercial high-level waste (CHLW); (2) panel alternation, in which SF and CHLW are emplaced in adjacent panels of rooms; (3) room alternation, in which SF and CHLW are emplaced in adjacent rooms within each panel; and (4) intimate mixture, in which SF and CHLW are emplaced in random order within each storage room. The study concludes that (1) cost is not an important factor; (2) the separate-areas and intimate-mixture alternatives appear, technically, to be more desirable than the other alternatives; and (3) the selection between the separate-areas and intimate mixture alternatives depends upon future resolution of site-specific and reprocessing questions. 5 refs., 6 figs., 12 tabs.

50757 (BMI/ONWI/C—175) Site study plan for routine laboratory rock mechanics, Deaf Smith County Site, Texas: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1987. Contract AC02-87CH10290. 50p. H. Order Number TI88016606/JAW.

This Site Study Plan for Routine Laboratory Rock Mechanics describes routine laboratory testing to be conducted on rock samples collected as part of the characterization of the Deaf Smith County site, Texas. This study plan describes the early laboratory testing. Additional testing may be required and the type and scope of testing will be dependent upon the results of the early testing. This study provides for measurements of index, hydrological, mechanical, and chemical properties with tests which are standardized and used widely in geotechnical investigations. Another Site Study Plan for Nonroutine Laboratory Rock Mechanics describes laboratory testing of samples from the site to determine mechanical, thermomechanical, and thermal properties by less widely used methods, many of which have been developed specifically for characterization of the site. Data from laboratory tests will be used for characterization of rock strata, design of shafts and underground facilities, and modeling of repository behavior in support of resolution of both preclosure and postclosure issues. A tentative testing schedule and milestone log are given. A quality assurance program will be utilized to assure that activities affecting quality are performed correctly and that appropriate documentation is maintained. 18 refs., 8 figs., 3 tabs.

50758 (BMI/ONWI/C—180) Repository seal materials performance for a SALT Repository Project 5-year code/model development plan: Draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Science Applications International Corp., San Francisco, CA (USA); Earth Technology Corp., Long Beach, CA (USA)). Jun 1987. Contract AC02-87CH10290. 107p. H. Order Number TI88015799/JAW.

This document describes an integrated laboratory testing and model development effort for the seal system for a high-level nuclear waste repository in salt. The testing and modeling efforts are designed to determine seal material response in the repository environment, to provide models of seal system components for performance assessment, and to assist in the development of seal system designs. A code/model development and performance analysis program will be performed to predict the short- and long-term response of seal materials and seal components. The results from these analyses will be used to support the material testing activities on this contract and to support performance assessment activities that are conducted in other parts of the Salt Repository Project (SRP). 48 refs., 15 figs., 4 tabs.

50759 (BMI/ONWI/C—182) Repository simulation model: Final report. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA)). Mar 1988. Contract AC02-87CH10290;AC02-83WM46656. 101p. H. Order Number TI88015666/JAW.

This report documents the application of computer simulation for the design analysis of the nuclear waste repository's waste handling and packaging operations. The Salt Repository Simulation Model was used to evaluate design alternatives during the conceptual design phase of the Salt Repository Project. Code development and verification was performed by the Office of Nuclear Waste Isolation (ONWL). The focus of this report is to relate the experience gained during the development and application of the Salt Repository Simulation Model to future repository design phases. Design of the repository's waste handling and packaging systems will require sophisticated analysis tools to evaluate complex operational and logistical design alternatives. Selection of these design alternatives in the Advanced Conceptual Design (ACD) and License Application Design (LAD) phases must be supported by analysis to demonstrate that the repository design will cost effectively meet DOE's mandated emplacement schedule and that uncertainties in the performance of the repository's systems have been objectively evaluated. Computer simulation of repository operations will provide future repository designers with data and insights that no other analytical form of analysis can provide. 6 refs., 10 figs.

50760 (BMI/ONWI/C—186-Vol.1) [Exploratory Shaft Project] 90% review technical specifications, Deaf Smith Site: Volume 1. (Parsons Brinckerhoff, Houston, TX (USA)). Jan 1988. Contract AC02-87CH10290;AC97-86WM46664. 615p. H. Order Number DE88014890/JAW.

This document contains the technical specifications for most of the structural components of the repository. Included are signoff sheets indicating the degree of review. (TEM)

50761 (BMI/ONWI/C—187) Documentation of SPECTROM-32: A finite element thermomechanical stress program: Part 1, Topical report RSI-0269: Draft. Callahan, G.D.; Fossum, A.F.; Svalstad, D.K. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; RE/SPEC, Inc., Albuquerque, NM (USA)). Feb 1986. Contract AC02-87CH10290;AC02-83CH10140. 1,410p. H. Order Number DE88015797/JAW.

SPECTROM-32 is a finite element program for the analysis of two- dimensional and axisymmetric inelastic thermomechanical problems related to the geological disposal of nuclear waste. The code is an integral part of the SPECTROM (Special Purpose Engineering Codes for Thermal/ROck Mechanics) series of special purpose computer programs that is continually being developed by RE/SPEC Inc. to address the many unique rock mechanics problems encountered in the analysis of the storage of radioactive wastes in geologic formations. This document presents the theoretical basis for the mathematical models, the finite element formulation and solution procedure of the program, a description of the input data for the program, example and verification problems, and details about program support and continuing documentation. The principal component models employed in the program involve thermoelastic, thermoviscoelastic, thermoelastic-plastic, and thermoviscoplastic types of material behavior. Special material considerations provide for the incorporation of limited-tension material behavior and consideration of jointed material behavior. Numerous program options provide the capabilities for various boundary conditions, sliding interfaces, excavation, arbitrary initial stresses, multiple material domains, load incrementation, plotting data base storage and access of results, and other special features unique to the geologic disposal of radioactive wastes. 3 refs., 7 figs., 5 tabs.

50762 (BMI/ONWI/C—191) Salt Repository Project Waste Package Program Plan: Draft. Carr, J.A.; Cunnane, J.C. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 10 May 1986. Contract AC02-87CH10290. 250p. H. Order Number TI88015667/JAW.

Under the direction of the Office of Civilian Radioactive Waste Management (OCRWM) created within the DOE by direction of the Nuclear Waste Policy Act of 1982 (NWPA), the mission of the Salt Repository Project (SRP) is to provide for the development of a candidate salt repository for disposal of high-level radioactive waste (HLW) and spent reactor fuel in a manner that fully protects the health and safety of the public and the quality of the environment. In consideration of the program needs and requirements discussed above, the SRP has decided to develop and issue this SRP Waste Package Program Plan. This document is intended to outline how the SRP plans to develop the waste package design and to show, with reasonable assurance, that the developed design will satisfy applicable requirements/performance objectives. 44 refs., 16 figs., 16 tabs.

50763 (BMI/ONWI/C—193) Site Study Plan for laboratory soil mechanics, Deaf Smith County site, Texas: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1987. Contract AC02-87CH10290. 46p. H. Order Number TI88015662/JAW.

This Site Study Plan for laboratory soil mechanics describes the laboratory testing to be conducted on soil samples collected as part of the characterization of the Deaf Smith County site, Texas. This study provides for measurements of index, mechanical, thermal, hydrologic, chemical, and mineral properties of soils from boring throughout the site. Samples will be taken from Playa Borings/Trenching, Transportation/Utilities Foundation Borings, Repository Surface Facilities Design Foundation Borings, and Exploratory Shaft Facilities Design Foundation Borings. Data from the laboratory tests will be used for soil strata characterization, design of foundations for surface structures, design of transportation facilities and utility structures, design of impoundments, design of shaft lining, design of the shaft freeze wall, shaft permitting, performance assessment calculations, and other program requirements. A tentative testing schedule and milestone log are given. A quality assurance program will be utilized to assure that activities affecting quality are performed correctly and that appropriate documentation is maintained. 18 refs., 6 figs., 3 tabs.

50764 (BMI/ONWI/C—195) Site study plan for borehole search and characterization, Deaf Smith County Site, Texas: Revision 1. (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). 22 Dec 1987. Contract AC02-87CH10290. 37p. H. Order Number DE88015660/JAW.

This site study plan describes the Borehole Search and Characterization field activities to be conducted during the early stages of Site Characterization at the Deaf Smith County site, Texas. The field program has been designed to provide data useful in addressing information/data needs resulting from Federal/State/Local regulatory requirements and repository program requirements. Air and ground surveys, an extensive literature search, and landowner interviews will be conducted to locate wells within and adjacent to the proposed nuclear waste repository site in Deaf Smith County. Initially, the study will center around the planned Exploratory Shaft Facilities location and will expand outward from that location. Findings from this study may lead to preparation of a new site study plan to search suspected borehole locations, and excavate or reenter known boreholes for additional characterization or remedial action. The Salt Repository Project (SRP) Networks specify the schedule under which the program will operate. The Technical Field Services Contractor (TFSC) is responsible for conducting the field program. Data will be handled and reported in accordance with established SRP procedures. A quality assurance program will be utilized to assure that activities affecting quality are performed correctly and that appropriate documentation is maintained. 13 refs., 6 figs., 3 tabs.

50765 (BMI/ONWI/C—198) 60% Review technical specifications, Deaf Smith Site. Gast, R.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Parsons Brinckerhoff, Houston, TX (USA)). Aug 1987. Contract AC02-87CH10290;AC97-86WM46664. 867p. H. Order Number TI88016869/JAW.

The enclosed documentation for the 60% Review Technical Specifications, Deaf Smith Site includes: Solicitation Documents which represent the eventual Federal Acquisition Regulations (FARs) and Department of Energy Acquisition Regulations

(DEARs) that will comprise a segment of the contractual documents for bidders attention; Contract Clauses that will become integral parts for the Fixed Price Construction Contracts applicable to the Exploratory Shaft Facility; Special Contract Requirements that will become contract provisions requiring specific contractor attention; Technical Specifications which have been completed for 60% submission, and the current list of 241 Contract Drawings that have been separately forwarded for review and comment.

50766 **(BMI/ONWI/C—199) Laboratory simulation of hydraulic fracturing stress measurements in salt.** Doe, T.; Boyce, G.; Majer, E. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Lawrence Livermore National Lab., CA (USA)). Nov 1985. Contract AC02-87CH10290;AC03-76SF00098. 142p. (LBL—17469). H. Order Number TI88016572/JAW.

This report discusses the results of a laboratory testing program to determine the validity of hydraulic fracturing stress measurements in salt. Tests were performed on 150 mm-diameter samples under hydrostatic conditions to determine influence of confining pressure, time delay between application of load and testing, flow rate, borehole diameter, polyaxial loading frame on blocks which were 30 {times} 30 {times} 46 cm to determine whether or not hydraulic fracturing could be used to detect nonhydrostatic stresses. 33 refs., 41 figs., 1 tab.

50767 **(BMI/ONWI/C—201) Radionuclide transport through perforations in nuclear waste containers.** Aidun, C.K.; Bloom, S.G.; Raines, G.E. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1987. Contract AC02-87CH10290. 36p. H. Order Number TI88016507/JAW.

Previous analytical models for the steady-state radionuclide release rate through perforations in nuclear waste containers into the surrounding medium are based on a zero wall thickness assumption. In this paper we investigate the effect of the wall thickness on the mass transfer rate through isolated cylindrical holes. We solve the steady-state diffusion equation for the concentration field and derive a model based on the analytical solution. By direct comparison, we show that the zero wall thickness model overpredicts the mass transfer rate by about 1300 percent for a circular hole with 1-cm radius and a wall thickness of 10 cm. As expected, the zero-thickness model becomes even less accurate as the hole radius decreases; it predicts a greater release rate from a large number of small holes than the mass transfer rate from an uncontained waste form cylinder. In contrast, the results predicted by our model remain bounded for isolated holes and never exceed the mass transfer from an uncontained waste form. 6 refs., 9 figs., 3 tabs.

50768 **(BMI/ONWI/C—205) Salt repository project waste package conceptual design, licensing strategy, and testing plans.** Schornhorst, J.R.; Miller, N.E. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1988. Contract AC02-87CH10290. 4p. H. Order Number TI88016510/JAW.

The conceptual design for the waste package is the first phase of a multiphase design effort. Its objective is to develop design concepts that are expected to satisfy the waste package design and regulatory requirements based on available engineering expertise and judgment and on preliminary analysis, evaluations, and data. The components of the waste package include the waste form, canister, container, and packing. A discussion of all requirements for the waste package is beyond the scope of this paper. However, the conceptual design has been most influenced by the Nuclear Regulatory Commission's requirements to provide substantially complete containment of the waste for up to 1000 years after repository closure, and to provide controlled release of radionuclides for the period from 1000 to 10,000 years after repository closure.

50769 **(BMI/ONWI/C—206) Site specific statutory compliance planning for the salt repository project at the Deaf Smith County Site, Texas: Requirements, strategy, and status: Revision 4.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1986. Contract AC02-87CH10290. 106p. H. Order Number TI88016509/JAW.

This document and the requirements and actions it presents are addressed to the Deaf Smith County Site, Texas. The proposed actions upon which the plan is based are those described in Chapters 4 and 5 of the final EA for the site. Similarly, the environmental and health and safety requirements covered in the plan are those identified in the EA as being potentially applicable to the salt repository project at the Deaf Smith site. 12 figs., 8 tabs.

50770 **(BMI/ONWI/C—207) Site study plan for regional hydrologic sampling and monitoring: Preliminary draft.** Dutton, A.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Texas Univ., Austin (USA). Bureau of Economic Geology). 26 Oct 1987. Contract AC02-87CH10290;AC97-83WM46651. 63p. H. Order Number TI88016514/JAW.

The purpose of the Regional Hydrologic Studies Plan is to describe those field activities required for completion of the objectives of hydrologic activities. Many of these activities are regional in scope and are designed to provide a framework for understanding the hydrologic setting of the site and the hydrologic processes that influence site characteristics. Site Study Plans (SSPs) define activates at and in the immediate vicinity of the site. The activities specified in the Regional Hydrologic Studies Plan are performed beyond the confines of the site because the hydrologic systems extend beyond the site boundaries, because pertinent data that bear on site suitability are available outside of the site, and because natural analogues exist outside of the site that allow analysis of processes that are expected to operate within the site. 15 refs., 5 figs., 1 tab.

50771 **(BMI/ONWI/C—208) Socioeconomic monitoring and mitigation plan for the Salt Repository Project Site, Deaf Smith County, Texas: Revision 5: Draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1988. Contract AC02-87CH10290. 91p. H. Order Number TI88016513/JAW.

The purpose of the Socioeconomic Monitoring and Mitigation Plan (SMMP) is to identify, in consultation with the affected States and Indian Tribes, potentially significant adverse socioeconomic impacts that could result from site characterization activities, to describe approaches that will be used to monitor any such identified impacts, and to describe procedures for mitigating them. Chapter 3 of the SMMP provides a description of site characterization phase activities planned to assess the geologic condition of the site and construction the exploratory shafts and surface support facilities. The rationale for developing socioeconomic monitoring studies is presented in Chapter 4. Chapter 5 contains descriptions of the socioeconomic monitoring and mitigation procedures whenever they are applicable. Additionally, in Chapter 6, the SMMP includes a procedure for modifying the monitoring and mitigation program and an approach for reporting monitoring results to interested parties. 8 refs., 20 figs., 4 tabs.

50772 **(BMI/ONWI/C—211) Thermal/thermomechanical analyses for the room region with horizontal and vertial modes of emplacement.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). [1988]. Contract AC02-87CH10290. 36p. H. Order Number TI88016605/JAW.

Extensive thermal/thermomechanical analyses of the Site Characterization Plan-Conceptual Design at the Deaf Smith county Site, Texas, have been carried out for the room region with horizontal and vertical modes of emplacement. The main purpose of this study is to make a good comparison between these two modes of emplacement in this region. Homogeneous and nonhomogeneous strata under isothermal or transient temperature conditions cases were considered in the analyses. Furthermore, various pillar widths for the vertical mode emplacement were also taken into consideration. Only spent fuel (SF) waste was considered in this study. Finite element method was used throughout the analyses. The thermal responses were evaluated using SPECTROM-41 while the thermomechanical responses were calculated using SPECTROM-32. Thermal and thermomechanical comparisons between the two modes of emplacement for various cases were presented in this paper.

50773 (BMI/ONWI/C—214) Travel path/travel time uncertainties at salt sites proposed for high-level waste repositories: Topical report. Andrews, R.W.; Kelley, V.A.; McNeish, J.A.; LaVenue, A.M.; Campbell, J.E. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Intera Technologies, Inc., Austin, TX (USA)). Jun 1986. Contract AC02-87CH10290;AC02-83CH10140. 371p. (ONWI—E512-02900/TR-36). H. Order Number TI88016442/JAW.

The pre-waste-emplacement ground-water travel time from the edge of the disturbed zone to the accessible environment is a performance measure which must be quantified to address the US Nuclear Regulatory Commission's (NRC) siting criteria and the US Department of Energy's (DOE) siting guidelines. The prediction of ground-water travel time has a significant degree of uncertainty due to (1) the lack of site-specific hydrogeologic data, (2) the spatial variability of hydrogeologic parameters, (3) the hydrogeologic conceptual model uncertainty, and (4) the lateral extent of the disturbed zone and accessible environment. This uncertainty in the predicted travel time must be quantified to the greatest extent possible in order to aid the regulators in their analysis of the suitability of the candidate repository sites. The present document details the travel time uncertainty at the seven proposed salt sites. The approach taken to quantify this uncertainty was to take samples from the distribution of hydrogeologic parameters (using Latin hypercube sampling) and to conduct multiple realizations of the expected ground-water travel path and travel time. This approach produced a travel time probability distribution function from which relevant statistical measures of the travel time distribution may be derived. The code used to generate the travel time distribution is called PTRACK (Thompson et al., 1986). 78 refs., 85 figs., 38 tabs.

50774 (BMI/ONWI/C—215) Hydrogeologic subdivision of the Wolfcamp series and Pennsylvanian system of the Swisher Study Area, Texas: Revision 1: Topical report. Siminitz, P.C.; Warman, E.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Aug 1987. Contract AC02-87CH10290. 97p. (ONWI/SUB—87/E512-05000-T47). H. Order Number TI88015796/JAW.

The Pennsylvanian-Wolfcamp section in the Palo Duro Basin includes brine aquifers that are considered to be the most important ground- water flow paths in the deep-basin system. This report provides summary documentation of studies that subdivide the section into hydrogeologic units based on their judged relative capacities for transmitting water. This particular study area comprises eight counties in Texas, including Swisher County. Underground patterns of rock distribution are delineated from a hydrologic perspective and at a level of detail appropriate for numerical modeling of regional ground-water flow. Hydrogeologic units are defined and characterized so that appropriate porosity and permeability values can be assigned to each during construction of the numerical models and so that modelers can combine units where necessary. Hydrogeologic units have been defined as mappable, physically continuous rock bodies that function in bulk as water-transmitting or water-retarding units relative to adjacent rocks. Interpretations are made primarily from geophysical logs. Hydrologic characteristics are assessed on the basis of properties typically associated with certain lithologies (e.g., sandstones are more pervious than shales) and on the basis of gross variations in effective porosity (particularly in carbonate sequences). 15 refs., 52 figs., 1 tab.

50775 (BMI/ONWI/C—224) Geologic mapping procedure: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Sep 1987. Contract AC02-87CH10290. 43p. H. Order Number TI88016434/JAW.

Geologic mapping will provide a baseline record of the subsurface geology in the shafts and drifts of the Exploratory Shaft Facility (ESF). This information will be essential in confirming the specific repository horizon, selecting representative locations for the in situ tests, providing information for construction and decommissioning seal designs, documenting the excavation effects, and in providing information for performance assessment, which relates to the ultimate suitability of the site as a nuclear waste repository. Geologic mapping will be undertaken on the walls and roof, and locally on the floor within the completed At-Depth Facility (ADF) and on the walls of the two access shafts. Periodic mapping of the exposed face may be conducted during construction of the ADF. The mapping will be oriented toward the collection and presentation of geologic information in an engineering format and the portrayal of detailed stratigraphic information which may be useful in confirmation of drillhole data collected as part of the surface-based testing program. Geologic mapping can be considered as a predictive tool as well as a means of checking design assumptions. This document provides a description of the required procedures for geologic mapping for the ESF. Included in this procedure is information that qualified technical personnel can use to collect the required types of geologic descriptions, at the appropriate level of detail. 5 refs., 3 figs., 1 tab.

50776 (BMI/ONWI/C—225) Geophysical borehole logging test procedure: Final draft. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Sep 1986. Contract AC02-87CH10290. 52p. H. Order Number TI88016599/JAW.

The purpose of geophysical borehole logging from the At-Depth Facility (ADF) is to provide information which will assist in characterizing the site geologic conditions and in classifying the engineering characteristics of the rock mass in the vicinity of the ADF. The direct goals of borehole logging include identification of lithologic units and their correlation from hole to hole, identification of fractured or otherwise porous or permeable zones, quantitative or semi-quantitative estimation of various formation properties, and evaluation of factors such as the borehole diameter and orientation. 11 figs., 4 tabs.

50777 (BMI/ONWI/C—226) Site study plan for geochemical analytical requirements and methodologies: Revision 1. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Dec 1987. Contract AC02-87CH10290. 254p. H. Order Number TI88016569/JAW.

This site study plan documents the analytical methodologies and procedures that will be used to analyze geochemically the rock and fluid samples collected during Site Characterization. Information relating to the quality aspects of these analyses is also provided, where available. Most of the proposed analytical procedures have been used previously on the program and are sufficiently sensitive to yield high-quality analyses. In a few cases improvements in analytical methodology (e.g., greater sensitivity, fewer interferences) are desired. Suggested improvements to these methodologies are discussed. In most cases these method-development activities have already been initiated. The primary source of rock and fluid samples for geochemical analysis during Site Characterization will be the drilling program, as described in various SRP Site Study Plans. The Salt Repository Project (SRP) Networks specify the schedule under which the program will operate. Drilling will not begin until after site ground water baseline conditions have been established. The Technical Field Services Contractor (TFSC) is responsible for conducting the field program of drilling and testing. Samples and data will be handled and reported in accordance with established SRP procedures. A quality assurance program will be utilized to assure that activities affecting quality are performed correctly and that the appropriate documentation is maintained. 28 refs., 9 figs., 14 tabs.

50778 (BMI/ONWI/C—230) Hydrogeologic subdivision of the Wolfcamp series and Pennsylvanian system of eastern Texas Panhandle, north-central Texas, and southwestern Oklahoma. Kayal, R.R.; Kistner, D.J.; Kranes, R.; Verock, F.P. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Mar 1987. Contract AC02-87CH10290;AC02-83CH10140. 132p. (ONWI/SUB—87/E512-05000-T53). H. Order Number TI88016440/JAW.

The Pennsylvanian-Wolfcamp section in the Palo Duro Basin includes brine aquifers that are considered to be the most important ground-water flow paths in the deep-basin system. This report is the fifth in a series providing summary documentation of

studies that subdivide the section into hydrogeologic units based on their judged relative capacities for transmitting water. This report extends the hydrogeologic study area to the eastern Texas Panhandle, north-central Texas, and southwestern Oklahoma. It includes 37 counties in Texas and Oklahoma. Underground patterns of rock distribution are delineated from a hydrologic perspective and at a level of detail appropriate for numerical modeling of regional ground-water flow. Hydrogeologic units are defined and characterized so that appropriate porosity and permeability values can be assigned to each unit during construction of the numerical models (not part of this study), and so that modelers can combine units where necessary. In this study, hydrogeologic units have been defined as mappable, physically continuous rock bodies that function in bulk as water-transmitting or water-retarding units relative to adjacent rocks. Interpretations are made primarily from geophysical logs. Hydrologic characteristics are assessed on the basis of properties typically associated with certain lithologies (e.g., sandstones are more pervious than shales) and on the basis of gross variations in effective porosity (particularly in carbonate sequences). 44 refs., 32 figs., 1 tab.

50779 **(BMI/ONWI/C—232) Interim evaluation of the predictive capability of salt constitutive laws.** DeVries, K.L.; Blankenship, D.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1987. Contract AC02-87CH10290;AC02-83CH10140. 282p. (RSI—0314). H. Order Number TI88016876/JAW.

The Exponential-Time, Krieg, and Munson-Dawson viscoplastic constitutive models are used in finite element simulations of laboratory, bench-scale, and field tests on Avery Island salt. The simulated laboratory tests were constant stress-rate tests. In these tests, the stress state is homogeneous in space, but varies through time. The simulated bench-scale tests were hydraulic fracturing tests, the state of stress in the salt specimen varies both in time and space. The simulated field tests were corejack tests performed in the Avery Island dome in Southern Louisiana. A corejack test consists of a 1-m-diameter, thick-walled hollow cylinder loaded with a constant pressure on the outside radius of the cylinder. In these tests, the stress state varies with space and is nearly constant through time. All of the simulations resulted in reasonable agreement with the measurements in the actual tests. 16 refs., 42 figs., 29 tabs.

50780 **(BMI/ONWI/C—234) Lessons learned from the preclosure performance assessment review of the Fluor Technology, Inc., draft site characterization plan conceptual design report.** Mayberry, J.J. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 9 Jun 1987. Contract AC02-87CH10290. 28p. H. Order Number TI88016967/JAW.

This report presents the lessons learned from the preclosure performance assessment review (PAR) of the Draft Site Characterization Plan---Conceptual Design Report (SCP-CDR). The PAR analyzes the operations of the waste handling facilities as presented in the SCP-CDR against appropriate regulatory and design criteria. The PAR applies to the design presented in a working draft released in April, 1986. We will analyze the design presented in the SCP-CDR, the other is to test safety assessment methods and tools. This report addresses only the second of these objectives. The PAR analysis consists of assessments of offsite and occupational doses resulting from routine and accidental events during preclosure operations at the repository. The activities related to the PAR are divided into subject areas. These areas include (1) the description of repository facilities and operations, (2) the development of radioactive material inventories and radiation dose rates, (3) the development of radioactive material-release scenarios and source terms, (4) the assessment of offsite dose equivalents, and (5) the assessment of occupational radiation dose equivalents. This report contains a summary of the analyses in these fives areas and lists those preclosure analyses not performed as part of the PAR. Chapters detail the strengths and weaknesses of each analysis and include recommendations for improving the analyses. 15 refs., 1 fig., 1 tab.

50781 **(BMI/ONWI/C—235) Manual convergence monitoring procedure: Final draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Aug 1986. Contract AC02-87CH10290. 42p. H. Order Number TI88016453/JAW.

This document provides the required procedure for performing convergence monitoring. Convergence monitoring design considerations and detailed descriptions of the locations and layout of the convergence monitoring stations are presented in the Shaft Instrumentation and Monitoring Test Plan and At-Depth Instrumentation and Testing Plan. Sufficient details are provided in this procedure to allow many applications. 2 refs., 12 figs.

50782 **(BMI/ONWI/C—245) Potential constitutive models for salt: Survey of phenomenology, micromechanisms, and equations.** Senseny, P.E.; Hansen, F.D. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA); RE/SPEC, Inc., Rapid City, SD (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83CH10140. 120p. (RSI—0284). H. Order Number TI88016451/JAW.

Results are given of a literature survey performed to document the thermomechanical phenomena and micromechanical processes observed for salt over the ranges of stress and temperature of interest for a high-level nuclear repository. The elastic and thermal expansion behavior of salt can be readily modeled by the generalized Duhamel Neumann form of Hooke's law with temperature-dependent elastic constants and coefficient of thermal expansion. Inelastic deformation is primarily viscoplastic, but also has a brittle component. The observed phenomenological behavior of salt occurs because of micromechanical processes. To the extent that these processes have been studied, a summary of deformation mechanisms in natural salt is included in this report. Eight constitutive models that appear to be capable of modeling the viscoplastic deformation have been selected from the literature. Two models have been selected to model brittle deformation. Insufficient data are available to develop a model for failure. 92 refs., 39 figs., 6 tabs.

50783 **(BMI/ONWI/C—250) Public information plan for National Waste Terminal Storage [NWTS] facilities project office of nuclear waste isolation program.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1 May 1979. Contract AC02-87CH10290. 11p. H. Order Number TI88016433/JAW.

The objectives of this plan are to assure the capability to provide updated scientific and technical knowledge on nuclear waste management to the public at large in understandable terms, and to increase interaction and discussions between federal program managers and institutions and organizations at the national and local levels, where desired by the institutions and organizations. The guidelines established herein are to allow for the preparation and dissemination of factual information in order to enhance understanding by federal, state, and local officials and the general public, and thereby encourage informed participation in the program by citizens and governments. This is consistent with the recommendations of the Interagency Review Group.

50784 **(BMI/ONWI/C—254(1)) Rock mechanics evaluation of potential repository sites in the Paradox, Permian, and Gulf Coast Basins: Volume 1.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; RE/SPEC, Inc., Rapid City, SD (USA)). Sep 1987. Contract AC02-87CH10290;AC02-83CH10140. 294p. (RSI—0302). H. Order Number TI88016596/JAW.

Thermal and thermomechanical analyses of a conceptual radioactive waste repository containing commercial and defense high-level wastes and spent fuel have been performing using finite element models. The thermal and thermomechanical responses of the waste package, disposal room, and repository regions were evaluated. four bedded salt formations, in Davis and Lavender Canyons in the Paradox Basin of southeastern Utah and in Deaf Smith and Swisher counties in the Permian Basin of northwestern Texas, and three salt domes, Vacherie Dome in northwestern Louisiana and Richton and Cypress Creek Domes in southeastern Mississippi, lo-

cated in the Gulf Coast Basin, were examined. In the Paradox Basin, the pressure exerted on the waste package overpack was much greater than the initial in situ stress. The disposal room closure was less than 10 percent after 5 years. Surface uplift was nominal, and no significant thermomechanical perturbation of the aquitards was observed. In the Permian Basin, the pressure exerted on the waste package overpack was greater than the initial in situ stress. The disposal room closures were greater than 10 percent in less than 5 years. Surface uplift was nominal, and no significant thermomechanical perturbation of the aquitards was observed. In the Gulf Coast Basin, the pressure exerted on the waste package overpack was greater than the initial in situ stress. The disposal room closures were greater than 10 percent in less than 5 years. No significant thermomechanical perturbation of the overlying geology was observed. 40 refs., 153 figs., 32 tabs.

50785 **(BMI/ONWI/C—255) Salt Repository Project closeout task report on Rod Consolidation Demonstration Program support.** (Battelle Memorial Inst., Hereford, TX (USA). Office of Nuclear Waste Isolation). 29 Apr 1988. Contract AC02-87CH10290. 71p. H. Order Number DE88016872/JAW.

The Rod Consolidation Demonstration Program is a four-phase program sponsored by the Office of Civilian Radioactive Waste Management (OCRWM) to develop and demonstrate spent fuel rod consolidation system technology at the Test Area North (TAN) facility at INEL. The Program has recently completed its second phase to the 90% level and three rod consolidation systems are being reviewed to select two of the systems to enter the third phase of the Program. The purpose of this closeout report is to provide a summary of three rod consolidation system designs, and an evaluation of the potential impacts of these systems on the repository waste handling building. The evaluation is based on prior experience of Battelle personnel at WIPP, INEL, and Hanford facilities. The information in this report is expected to be of interest to those involved in the Rod Consolidation Demonstration Program and to be applicable to waste handling building design work that will be done at Nevada, MRS, or other repository facilities where rod consolidation may be done. 6 refs., 35 figs.

50786 **(BMI/ONWI/C—256) Salt generic system requirements specification for a mined geologic disposal system in salt: Preliminary draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). [1988]. Contract AC02-87CH10290. 186p. H. Order Number TI88016594/JAW.

This document provides the guidance necessary to ensure that the designers of an MGDSS address certain minimum requirements. The SRP should comply with applicable state and local laws and regulations that are consistent with Federal regulations and which are premised on valid state and local responsibilities. Industry codes and standards should be given due consideration and applied where they are applicable. The SG-SRS lists, in the order of the system breakdown, definitions, functional requirements, performance criteria, and constraints to a level of detail that is considered applicable to any MGDSS.

50787 **(BMI/ONWI/C—258) Single-hole permeabiity test procedure: Final draft.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Golder Associates, Inc., Redmond, WA (USA)). Dec 1986. Contract AC02-87CH10290. 76p. H. Order Number TI88016593/JAW.

Single-hole permeability tests will be carried out to evaluate the intrinsic permeability of strata encountered in boreholes drilled from within the shafts and the underground drifts of the Exploratory Shaft Facility (ESF). Intrinsic permeability values will be interpreted from transmissivity or hydraulic-conductivity values determined by analysis of transient pressure or hydraulic-conductivity values determined by analysis of transient pressure and flow data for each test, taking due account of the density and dynamic viscosity of the fluid used as permeant in each case. Single-hole tests are suitable for testing the relatively low permeability media anticipated for the ESF. However, the tests evaluate only a small volume of rock, and hence the parameters obtained will be considered spot measurements. If the results of single-hole testing indicate zones of relatively high intrinsic permeability, or if large-scale hydrologic measurements are required, then cross-hole permeability tests or cross-hole tracer tests will be carried out. These tests will be the subject of separate test procedures. 34 refs., 17 figs., 1 tab.

50788 **(BMI/ONWI/C—259) Social assessment methods recommendation report: Draft: Revision 1.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). May 1986. Contract AC02-87CH10290. 237p. H. Order Number TI88016592/JAW.

This report recommends an approach to the Salt Repository Project Office (SRPO) for assessing the social impacts of a high-level nuclear waste repository. The report establishes several criteria for selecting an approach and then describes and evaluates existing social assessment approaches against the selection criteria. Based upon these evaluations a recommendation is made. The proposed modifications include suggestions to strengthen the approach by including elements of other methods. Suggestions for the development of community surveys and local leader interviews are also made. 64 refs., 4 figs., 14 tabs.

50789 **(BMI/ONWI/C—260) Social assessment methods recommendation report: Draft, May 1986.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Nov 1986. Contract AC02-87CH10290. 25p. H. Order Number TI88016591/JAW.

These recommendations reflect the Peer Review Panel positions on each issue. The recommendations were developed following a day-long discussion held by the Review Panel. These recommendations were reviewed by each Panelist. Significant disagreements within the Panel are noted, and, of course, not all members shared identical perspectives on each issue. The order in which these recommendations are listed and discussed also reflects a general prioritizing by the Panel, although the Panel also agrees that all recommendations included here are of major importance to the project.

50790 **(BMI/ONWI/C—276) ONWI socioeconomic activities in support of SRPO socioeconomic program.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1986. Contract AC02-87CH10290. 54p. H. Order Number TI88016879/JAW.

The introduction describes the purpose of ONWI's Socioeconomic Program for SRPO nuclear waste repository program and the organization within ONWI dedicated to socioeconomic activities. Chapter 2 of this report, Statutory Requirements and Mission Plan Strategy, documents the specific directives and guidelines contained in the NWPA and in the Mission Plan that define DOE's socioeconomic responsibilities. Chapter 3, ONWI Socioeconomic Objectives and Activities to Assist SRPO, describes ONWI's socioeconomic objectives and provides a detailed discussion of the major activities planned to assist SRPO in the impact assessment, mitigation, and monitoring phases of the program. Chapter 4 lists references cited in the report. 15 refs., 8 figs., 3 tabs.

50791 **(BMI/ONWI/C—279) Palo Duro microearthquake network operation report for January to June 1986.** Acharya, H.; Tyrala, L. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Stone and Webster Engineering Corp., Boston, MA (USA)). Nov 1986. Contract AC02-87CH10290;AC02-83CH10140. 141p. (ONWI/SUB—86/E512-05000-T56). H. Order Number TI88016436/JAW.

A 16-station network operates in the Texas Panhandle to monitor earthquake activity in the area. This report describes the network and its operation as well as analysis of data obtained during the period of January 1 to June 30, 1986. The network continued to operate satisfactorily during this period. Several local and regional earthquakes were detected and located during this period. These earthquakes occurred in the northern half of the Texas Panhandle and were small (magnitude {<=}3.0). None of the earthquakes was felt. Mansfield Station continued to detect a number of very small earthquakes occurring near the station, but it was not possible to locate them since no other station detected them. All elements of the microearthquake network were tested and checked

in March and June as part of the Stone & Webster Engineering Corporation (SWEC) quarterly maintenance program. At several stations modifications were carried out to improve the quality of recorded data. These included placing the seismometer at a depth of 50 ft and raising the antenna to a height of 50 ft. 4 refs., 7 figs., 9 tabs.

50792 **(BMI/ONWI/C—284) Salt repository project retrieval strategy study: Draft: Technical report.** Tome', R.L.; Smith, S.C.; Howe, K.E.L.; Smith, L.A.; Querns, W.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA)). Dec 1987. Contract AC02-87CH10290;AC02-83CH10140. 313p. (BMI/ONWI—697). H. Order Number DE88016968/JAW.

This study presents a preliminary overview of the Salt Repository Project's waste retrieval strategy for compliance with the DOE and other government requirements. Presented is the retrieval strategy, system approach, and program necessary to go from the conceptual design waste retrieval concept through the following: advanced conceptual retrieval design and demonstration; license application retrieval design and testing; submittal of retrieval-based license application design and input; and equipment testing, prototype retrieval engineering, and associated retrieval option maintenance evaluations for all repository program phases. This work is a cooperative effort involving the input of a multidiscipline working group and building on the efforts of previous repository program studies on waste retrieval. Included in this document are descriptions of the salt repository program operational concepts on emplacement, postemplacement, and retrieval, as well as interpretations of retrieval-related institutional and design requirements and criteria. Conditions expected during a waste retrieval operation are discussed. Also, preliminary plans for future work, both proof-of-principle demonstration and associated retrieval design activities, are presented, followed by an order-of-magnitude cost estimate and schedule for the future work. 35 refs., 40 figs., 4 tabs.

50793 **(BMI/ONWI/C—285) A socioeconomic monitoring program for site characterization and repository development: Final report.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1986. Contract AC02-87CH10290. 75p. H. Order Number TI88016419/JAW.

This report describes a socioeconomic monitoring program for site characterization and repository development in connection with a salt site under consideration by the US Department of Energy's Civilian Radioactive Waste Management (CRWM) program. The report first establishes design criteria for monitoring programs, and then describes and evaluates 13 existing monitoring systems. Finally, the report recommends a socioeconomic monitoring program for use at a salt site. Suitable elements of the surveyed existing programs are combined with additional elements identified as requirements for the CRWM program. 76 refs., 5 figs., 6 tabs.

50794 **(BMU—1987-174) SFR - the Swedish final storage site for LAW and MAW. General description and preliminary findings on safety aspects in the operating phase.** Mielke, H.G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1987. 38p. (In German). (GRS-A—1336). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The report describes the safety aspects to be considered during the operation of the final dump. For this purpose, a description of the location, the radioactive wastes and the technical conception of the final dump SFR is given. The safety considerations in PSR deduced from this, as well as the most important aspects of the expert opinion on the operation phase by the SKI are presented, and the experience made up to now in the operation of the final dump in Sweden are summarized. The proceedings in Sweden and in the Federal Republic of Germany with regard to safety considerations for the operation phase are compared and differences are pointed out.

50795 (CONF-760202—, pp 172-181) **Reduction in radiation exposure and volume using asphalt solidification.** Stewart, J.E. (Werner & Pfleiderer Corporation, Waldwick, NJ (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The solidification of liquid and solid radioactive wastes from nuclear power plants with an extruder-evaporator using an asphalt binder minimizes both volume and radiation exposure. The automatic evaporation of water in liquid radwastes prior to incorporation into asphalt reduces the volume to be transported and disposed. In turn, the numbers of drums requiring handling is reduced 5 to 10 times thereby lessening the chances for radiation exposure. Also, the extruder-evaporator is self-shielded and contains only about one gallon of the radwaste. Dose rates at the surface of the equipment and filled containers from commercially operating systems for the past 10 years in Europe are given.

50796 (CONF-760202—, pp 182-186) **New facility for processing and storage of radioactive and toxic chemical waste.** Gallagher, F.E. III. (Univ. of California, Santa Barbara (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A new facility for the processing and storage of radioactive and toxic chemical waste is described. The facility is located in the science and engineering complex of the Santa Barbara campus of the University of California, near the Pacific Ocean. It is designed to provide a safe and secure processing and storage area for hazardous wastes, while meeting the high aesthetic standards and ecological requirements of campus and community regulatory boards. The ventilation system and fire prevention features will be described in detail. During the design phase, a small laboratory was added to provide an area for the radiation protection and industrial hygiene programs. Operational experience with this new facility is discussed.

50797 (CONF-760202—, pp 187-190) **Preliminary investigation of the properties of absorbent materials used in the packaging of low-level radioactive liquid wastes.** Otis, M.D.; Martin, J.B.; Courtney, J.W.; Garnett, J.E. (Univ. of Colorado, Boulder (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Transportation regulations require provision for the absorption of potential leakage of packaged radioactive liquids. Certain radioactive liquid shipments require absorbents with a retention capacity of twice the liquid volume. While vermiculite is widely recommended, insufficient consideration has been given to the absorbent properties of vermiculite and alternative substances. In order to optimize the packaging of low-level radioactive liquid waste, several types of absorbents were tested. The properties of interest included the retention capacity for organic solvents, aqueous solutions, and mixtures of the two. The disposal of liquid scintillation solutions posed the problem that prompted this investigation. The double-absorbent requirement cannot be justified in the packaging of such waste. A recommendation is made that they be packed in bulk using single-absorbent capacity. Fine grade vermiculite, diatomaceous earth, or expanded perlite are recommended for this purpose although there may by other equivalent absorbents.

50798 (CONF-760202—, pp 735-741) **Guidelines for cleanup of uranium tailings from inactive mills.** Goldsmith, W.A.; Haywood, F.F.; Jacobs, D.G. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Recent experiences in Grand Junction, Colorado, have indicated the significance of uranium tailings as sources of nonoccupational exposure and suggest that current methods for perpetual care and isolation of the large areas covered by tailing piles at inactive mill locations may be inadequate for minimizing human exposure.

This paper presents the rationale and the procedures used in reviewing the adequacy of proposed criteria for remedial action at these sites. Exposures due to aquatic, terrestrial, airborne, and direct contamination pathways were compared to determine the most important radionuclides in the pile and their pathways to man. It is shown that the most hazardous components of the tailings are ^{226}Ra and ^{230}Th. The long half-lives of these radionuclides require the consideration occupancy of the vacated site at some future time, even if the immediately projected land use does not anticipate maximum exposure.

50799 **(CONF-870306—76) Regulation of spent nuclear fuel shipment: A state perspective.** Halstead, R.J.; Sinderbrand, C.; Woodbury, D. (Wisconsin Radioactive Waste Review Board, Madison (USA); Wisconsin Dept. of Justice, Madison (USA); Wisconsin Dept. of Natural Resources, Madison (USA)). 1987. Contract FG02-83NE44347. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014799/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

In 1985, the Wisconsin Department of Natural Resources (WDNR) sought to regulate rail shipments of spent nuclear fuel through the state, because federal regulations did not adequately protect the environmentally sensitive corridor along the route of the shipments. A state interagency working group identified five serious deficiencies in overall federal regulatory scheme: 1) failure to consider the safety or environmental risks associated with selected routes; 2) abscence of route-specific emergency response planning; 3) failure of the NRC to regulate the carrier of spent nuclear fuel or consider its safety record; 4) abscence of requirements for determination of need for, or the propriety of, specific shipments of spent nuclear fuel; and 5) the lack of any opportunity for meaningful public participation with respect to the decision to transport spent nuclear fuel. Pursuant to Wisconsin's hazardous substance statutes, the WDNR issues an order requiring the utility to file a spill prevention and mitigation plan or cease shipping through Wisconsin. A state trial court judge upheld the utility's challenge to Wisconsin's spill plan requirements, based on federal preemption of state authority. The state is now proposing federal legislation which would require: 1) NRC determination of need prior to approval of offsite shipment of spent fuel by the licensees; 2) NRC assessment of the potential environmental impacts of shipments along the proposed route, and comparative evaluation of alternative modes and routes; and 3) NRC approval of a route-specific emergency response and mitigation plan, including local training and periodic exercises. Additionally, the proposed legislation would authorize States and Indian Tribes to establish regulatory programs providing for permits, inspection, contingency plans for monitoring, containments, cleanup and decontamination, surveillance, enforcement and reasonable fees. 15 refs.

50800 **(CONF-8611263—) HOCUS cruise report.** Papucci, C. (ed.). (OECD/NEA Seabed Working Group, 75 - Paris (France); ENEA, Rome (Italy)). 1986. 302p. NTIS (US Sales Only), PC A13. Order Number DE88013179/JAW.

From OECD/NEA Seabed Working Group meeting; Antibes, France (4 Nov 1986).

HOCUS has provided the first opportunity to observe the behavior and measure the properties of seabed sediments disturbed by the entry of a penetrator. Visual inspection of the impact points has confirmed that a penetrator does not leave an open pathway. The seabed platform has been used to probe both entry pathways and undisturbed sediments. Piezocone penetration and dissipation tests have measured no changes in sediment property due to disturbance caused by the penetrators. The seabed platform has been used also for coring. Analyses of cores taken in undisturbed sediments and over the entry points of penetrators have found evidence that surface sediments have been drawn downwards, but no indication that the properties of the disturbed sediments have been significantly affected except, in one case, in the uppermost metre of core some softening was measured. Sediments at the Antibes site differ from those of the deep ocean by processing greater stiffness and greater insensitivity to remoulding.

50801 **(DOE/CH/10140—03(87-3)) Salt repository project: Technical progress report for the quarter 1 April--30 June 1987.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1987. Contract AC02-87CH10290;AC02-83CH10140. 113p. H. Order Number TI88016607/JAW.

This document reports the progress being made each quarter on the development of a geologic repository in salt for the permanent disposal of high-level nuclear waste. The reporting elements are arranged by the work breakdown structure so that related studies are presented together. The studies are reported by the Office of Nuclear Waste Isolation, a prime contractor of the US Department of Energy (DOE) Salt Repository Project Office. The studies include work by other DOE prime contractors and by contractors to the Office of Nuclear Waste Isolation.

50802 **(DOE/CH/46656—11) Two-phase repository construction concept: Engineering feasibility study.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Fluor Technology, Inc., Irvine, CA (USA)). Jul 1987. Contract AC02-87CH10290;AC02-83WM46656. 198p. (BMI/ONWI/C—48). OSTI, PO Bx 62, Oak Ridge, TN 3783109. Order Number TI88013316/JAW.

As part of the Conceptual Design of a High Level Nuclear Waste Repository in Salt, and Engineering Feasibility Study was performed to evaluate the validity of the proposed two-phase repository construction concept as described in the Mission Plan. As a result of this study, the two-phase repository construction concept can be considered valid. The uncertainty associated with the site-related permitting and licensing process remains the major element of risk to the program schedule. With the application of the two-phase approach, surface and subsurface construction activities can be removed from the critical path. For this study, the Davis Canyon, Utah site was used. The study includes preliminary designs of the two-phase repository, surface and subsurface layouts, an overall integrated schedule, and cost estimates and evaluations regarding schedule and technical issues. 4 refs., 19 figs., 21 tabs.

50803 **(DOE/DP—0059) Program implementation plan: Defense waste and transportation management.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Defense Waste and Transportation Management). Aug 1988. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016984/JAW.

This document describes DOE's current plans for managing the disposal of High Level Waste, Transuranic waste, and Low Level Waste (LLW) from atomic energy defense activities. It documents the implementation of the HLW and TRU waste policies as stated in the Defense Waste Management Plan (DWMP) (DOE/DP-0015), dated June 1983, and additionally addresses the disposal of LLW. A reference plan for each of the waste types describes the sequence of steps leading to disposal. Not all final decisions that concern the activities described in this document have been made. These decisions will depend on completion of the National Environmental Policy Act (NEPA) process, authorization and appropriation of funds, agreement with states as appropriate, and in some cases, the results of data collected from pilot experiments and operational experience.

50804 **(DOE/EA—0362) Y-12 RCRA closure initiation projects: Revised final environmental assessment.** (Wan (Lee) and Associates, Inc., Oak Ridge, TN (USA)). 28 Jun 1988. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016376/JAW.

The program that addresses all remedial action work at the plant is the Y-12 Remedial Action Program (RAP). A major subproject within this program is the Closure and Post-Closure Activities (CAPCA) Project. This project encompasses the RCRA mandated closures and associated post-closure monitoring and/or remediation of eight hazardous waste land disposal based units at the Plant. The closure plans for seven of the eight units have been approved by the TDHE. These include the two Oil Retentioin Ponds, Chestnut Ridge Security Pits, S-3 Ponds, Oil Landfarm, the Bear Creek Burial Grounds, New Hope Pond, and the Chestnut Ridge Sediment Disposal Basin. The environmental impact of the closure

of these sites, the construction of a replacement facility for New Hope Pond, and the opening of two borrow areas to support these closures will be assessed in this document. To the extent possible, the cumulative effects of closing these sites in a compressed time frame are considered. Once the closure plan for the remaining unit (Kerr Hollow Quarry) is available, an addendum to this document will be issued, and the associated environmental effects will be assessed. 35 refs., 18 figs., 13 tabs.

50805 **(DOE/ID/12499—4) Long-term site management plan for the LLRW [low-level radioactive waste] disposal area at West Valley, New York: Task 3: Final report.** (New York State Energy Research and Development Authority, Albany (USA); Envirosphere Co., New York (USA)). Feb 1987. Contract FG07-84ID12499. 237p. (MISC—88039). NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88015205/JAW.

The New York State Energy Research and Development Authority has sponsored a project to develop an integrated set of site management plans for the West Valley low-level radioactive waste (LLRW) disposal area. The plans were directed to upgrade the disposal area so that passive custodial care and monitoring activities would be sufficient to protect public health and safety and the environment. Task 3 Long-Term Site Management Plan, is the subject of this report. The goal of Task 3 was to select a long-term site management plan that would result in a stabilized site which would require only passive maintenance activities. The objectives of Task 3 were to formulate and evaluate alternative long-term strategies. The following seven system plans were conceptualized for a comparative assessment: Precast Concrete Vault, Structural Glacial Fill cover, Structural Clay Cover, Dynamic Compaction with a Semi-Structural Clay Cap, Displacement piles with a Semi-Structural Clay Cap, Grouting with a Semi-Structural Clay Cap, and Active Maintenance/Final Closure with a Semi-Structural Clay Cap. The Energy Authority's basis for selecting its preferred alternative is described. Based upon this chosen alternative, a scale model demonstration project is presented to test some of the engineered remediation techniques. 53 refs., 20 figs., 18 tabs.

50806 **(DOE/RL—88-04) Interim status of closure/post-closure plan for 183-H solar evaporation basins.** (Westinghouse Hanford Co., Richland, WA (USA)). Mar 1988. Contract AC06-87RL10930. 597p. NTIS, PC A25/MF A01; 1; GPO Dep. Order Number DE88015614/JAW.

This report describes a plan for decommissioning several solar evaporation basins on the Hanford reservation. The document describes procedures for sampling during decommissioning and a plan for certification of the resulting completed landfill. Additional plans deal with the training, security of the site, and post-closure monitoring. (TEM)

50807 **(DOE/RL—88-05) US Department of Energy: Richland Operations Office 1988 biennial waste minimization report.** (Westinghouse Hanford Co., Richland, WA (USA)). Mar 1988. Contract AC06-87RL10930. 42p. NTIS, PC A03. Order Number DE88015599/JAW.

This biennial report has been prepared to meet the March 1, 1988, US Environmental Protection Agency milestone for documentation of the Hanford Site's waste minimization activities and accomplishments. The report addresses activities which are undertaken by the US Department of Energy-Richland Operations Office through contractor organizations to reduce the quantity or volume and toxicity of waste generated in support of Hanford's ongoing waste management programs. To the extent possible, the waste minimization have been reported in quantitative terms. Although the concept and implementation of waste minimization at the Hanford Site is relatively new, substantial reductions in the amount or toxicity of certain waste types have been achieved. As implementation of the waste disposal costs and improvements in operational, efficiency will provide further incentives for continued generator reductions. 6 refs.

50808 **(DOE/RL—88-09) Final status post-closure permit application 183-H solar evaporation basins.** (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 478p. NTIS, PC A21/MF A01; 1; GPO Dep. Order Number DE88015616/JAW.

The US Department of Energy, and Westinghouse Hanford Company (WHC) have prepared the attached document (FSPCPA) and State Environmental Policy Act (SEPA) Checklist in response to ecology's letters. Colored photographs and a revised Part A Form 3 have been included in map holders at the front of the submittal to facilitate their usage; corresponding reproductions are located appropriately within the text. This document, along with the Interim Status Closure/Post-Closure Plan addresses the comments raised by the Ecology staff, and replaces all prior (pre-1988) submittals and certifications pertaining to the 183-H Solar Evaporation Basins. The Part A Form and SEPA Checklist contain information obtained after the March 1988 submittal; therefore, they replace the March submittal information.

50809 **(DP-MS—86-92) Economic analysis of projected high-level waste immobilization operations at the Savannah River Plant.** McDonell, W.R. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 10p. (CONF-860905—39). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014298/JAW.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

A model has been defined and input established for the projection of operating costs for processing high-level radioactive wastes to solid form in the Defense Waste Processing Facility (DWPF). The projected costs (expressed in categories designated essential materials, utilities, manpower, and overhead) determine economic incentives for process optimization in both near-term DWPF operations and long-term waste generation at the Savannah River Plant (SRP). The process model, though not predictive of specific modes of DWPF operation, permits evaluation of incremental costs in circumstances involving large backlogs of accumulated waste.

50810 **(DP-MS—86-98) Design and testing of the defense waste processing facility melter drain valve.** Edwards, R. Jr.; Glascock, J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1986. Contract AC09-76SR00001. 8p. (CONF-860905—40). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014811/JAW.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

The Defense Waste Processing Facility (DWPF) at the Savannah River Plant will use a joule-heated glass melter to process high-level radioactive defense waste into a borosilicate glass waste form. A prototype of a valve to drain the remaining glass from the melter at the end of its useful life is being tested at the Equipment Test Facility of the Savannah River Laboratory. The objective is to demonstrate the mechanical functionality of the valve and to uncover and solve problems related to its operation in the DWPF. 4 refs., 2 figs.

50811 **(DP-MS—86-122) Section A5 Drywell/Berm concept for the storage of HLRW canisters: Survey and assessment of radioactive waste management facilities in the United States: Addendum.** (Bechtel National, Inc., San Francisco, CA (USA)). Jun 1986. Contract AC09-76SR00001. 14p. NTIS, PC A03. Order Number DE88014303/JAW.

The Waste Processing Facility (DWPF) being constructed at the DOE Savannah River Plant is designed to produce approximately 460 canisters of vitrified high-level radioactive waste per year. Because a geologic repository for the disposal of the waste is not expected to be available before 1998, on-site facilities are required for the storage of waste canisters produced during a 10-year period. The concept selected for the onsite storage is an air-cooled vault (glass waste storage building). One of the alternative storage methods considered was the use of drywells constructed in an earthen berm. The following is a summary of the evaluation of the drywell/berm storage concept that was part of a study prepared in connection with work done under a Subcontract to Contract No. AC09-76SR00001 with the US Department of Energy. 8 figs.

50812 **(DPST—87-247) Summary of campaigns SGM-4 and SGM-5 of the DWPF scale glass melter.** Crow, K.R.; Weisman, A.F.; Guidotti, P.D.; Wehner, A.M.; Griffin, G.A.; Micallef, J.M.; O'Rourke, J.M.; Yoshioka, M. (Savannah River Lab., Aiken, SC (USA)). 18 Mar 1988. Contract AC09-76SR00001. 97p. NTIS, PC A05. Order Number DE88016057/JAW.

The fourth and fifth campaigns of the DWPF Scale Glass Melter were completed 11/2/86 and 12/10/86, respectively. One slurry batch was used for both campaigns. The slurry was a sludge-only simulation with frit-168; it did not include precipitate hydrolysis product. The maximum melt rate attained was 7.9 lb/hr ft^2, and total glass production was 29,300 lbs. Primary objectives of the campaigns were to evaluate and improve operation of the melter feed system and glass pouring system. This report includes detailed discussions of feed system performance, glass melting and pouring, off-gas treatment, sampling techniques, and instrumentation. Most of the results are applicable to the DWPF, and some have already impacted DWPF design. 8 refs., 66 figs., 30 tabs.

50813 **(DPST—87-491) Research melter feed additives study.** Carter, J.T. (Savannah River Lab., Aiken, SC (USA)). 29 May 1987. Contract AC09-76SR00001. 11p. NTIS, PC A03/MF A01. Order Number DE88016069/JAW.

The 774-A Research Melter recently completed a series of runs to determine a feed additive capable of increasing the glass melting rate. The experimental plan was based upon operating experiences during West Valley Nuclear Corporation's pilot plant campaigns. Their observations had yielded a correlation of soluble calcium vs glass melting rate. The test plan included three runs using Sludge-Only Frit 165 based feed and three runs designed to vary the amount of soluble calcium. Nitric acid was added to increase the soluble calcium and duplicate the West Valley pilot plant operation, sodium fluoride was added to reduce the soluble calcium (while not reducing the pH), and sodium nitrate was added to check for nitrate effects. The feed treated with nitric acid melted 50% faster than any other material. Nitric acid as a feed additive may allow the glass to become more oxidizing with a less likelihood of forming metals in the glass melt. 2 refs., 1 fig., 5 tabs.

50814 **(DPST—87-524) A 3-D heat transfer model of the IDMS melter.** Nash, C.A. (Savannah River Lab., Aiken, SC (USA)). 1 Jul 1987. Contract AC09-76SR00001. 16p. NTIS, PC A03/MF A01. Order Number DE88016068/JAW.

A 3-D model of the IDMS, or tenth scale melter shell and riser was created to examine temperature profiles. Glass temperatures above 1050{degree}C are desired, and spinel is expected to form at temperatures below 950{degree}C. The main purpose of the model was to examine profiles around the throat area of the melter, where molten glass passes from the melt pool into the riser. The melter has a 2 ft diameter melt pool, yet the riser/pour spout heater assembly is in the same position as it is for the scale melter, which has a 4 ft diameter melt pool. The 1 ft refractory tunnel connecting the IDMS melt pool to the riser entrance is unique to this melter. 10 figs.

50815 **(DPST—87-691) Requirements for WCP initial actions: II, Projections of chemical composition and radionuclide inventory of SRP [Savannah River Plant] waste streams.** Plodinec, M.J. (Savannah River Lab., Aiken, SC (USA)). 30 Sep 1987. Contract AC09-76SR00001. 3p. NTIS, PC A02/MF A01. Order Number DE88016051/JAW.

The Waste Acceptance Preliminary Specifications (WAPS) call for projections of the chemical composition, and radionuclide inventory, of DWPF glass. Your group has the responsibility for providing the composition of the waste, and for providing radionuclide inventory information. This report details the requirements for these activities: A description of the methods to be used to make the chemical composition and radionuclide inventory projections is needed by October 1, 1987, for revision of the Waste Form Compliance Plan; Chemical composition projections are needed by November 1, 1987, so that testing required by WAPS 1.1, 1.3, and 1.4 can be completed by June 1988; Radionuclide inventory projections can be provided at a later date, but no later than second quarter 1988.

50816 **(DPST—87-784) Canister Decontamination Chamber No. 1 operability test results.** Magoulas, V.E. (Savannah River Lab., Aiken, SC (USA)). 30 Oct 1987. Contract AC09-76SR00001. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016049/JAW.

The DWPF Canister Decontamination Chamber No. 1 (CDC) was installed at the TNX facility in October, 1986 for operability testing. Operability testing was required because this equipment is unique and is a critical part of the defense waste process. The test was successful in demonstrating the canister decontamination operation. Testing verified proper nozzle locations, frit suspension, level probe and CCTV operations. The following recommendations are based on data obtained from frit blasting 24 canisters: reduce the recirculation pump speed, to allow proper level probes operation; add an extension to the chamber rinse nozzle which allows removal of frit from the top of the upper guide rinse nozzle; increase visibility through the CCTV camera; make the CMM grapple jaw pins more compatible with the MSM; and improve canister guide capability to aid in canister loading. CDC Operability Testing was completed October, 1987. 6 refs., 11 figs., 2 tabs.

50817 **(EGG-M—88092) DOE defense low-level waste classification: Basis and application.** Halford, D.K. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 7p. (CONF-880510—3; IAEA-SM—3-3/130). NTIS, PC A02/MF A01. Order Number TI88015117/JAW.

From International symposium on the management of low and intermediate level radioactive wastes; Stockholm, Sweden (16 May 1988).

A process for developing a site-specific low-level radioactive waste (LLW) classification system for Department of Energy (DOE) defense LLW is being considered. Waste classification is a mechanism that can help ensure that overall performance objectives established to protect public health and safety, will be met. DOE has adopted ICRP 30 and ICRP 48 as the bases for all internal dose calculations. For LLW management, DOE is requiring equivalency with Nuclear Regulatory Commission (NRC) requirements. However, system- wide classification will be less practical for DOE than NRC because of dissimilarities of waste mixtures between DOE sites. Site-specific waste stream characterization, source-term determination, and radiological performance assessment will be required for DOE disposal facilities to determine the maximum disposal capacity and the most efficient disposal practices for defense LLW. This process will also demonstrate compliance with the overall performance objectives, thus providing for public health and safety. This paper discusses the procedure that DOE is considering in the development of a site- and waste-specific LLW classification system for DOE defense wastes. 10 refs., 1 tab.

50818 **(INIS-mf—11757) Determination of the corrosion mechanisms of high level waste containing glass. Reported period: January 1, 1983 - February 28, 1985. Final report.** Conradt, R.; Roggendorf, H. (Fraunhofer-Institut fuer Silicatforschung (ISC), Wuerzburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 21 Mar 1985. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754320/JAW.

In the present report, the inactive HLW glass SM 58 LW 11, doped with simulated 'radioactive' waste, was investigated under the following corrosion conditions: temperatures up to 200/ sup 0/C; pressure of 130 bar; corrosion in Q-solution, a highly concentrated salt brine. The aim of the investigations was to identify the rate controlling step of the corrosion process and to determine the correct type of time dependence of the whole process for long times. In particular, the effects of layers formed on the corroding glass and of reaction products accumulated in the leachant, had to be examined for this purpose. The basic mechanism is a network dissolution process proceeding proportional to the corrosion time. The initial period is followed by an intermediate one during which the process proceeds slower than linearly with time. The duration of this period depends on the amount of leachant per glass surface area. Finally, a linear time law is observed again, proceeding at a rate smaller than the initial one. By no means, a permanent stop of the whole process must be expected. The intermediate deviations from a linear time law are due to the accumulation of reaction

products in the leachant. Any layers formed during the corrosion process are unprotective against the further corrosion attack. (orig.) With 11 refs., 16 tabs., 8 figs.

50819 **(INIS-mf—11758) Determination of the corrosion mechanisms of high level waste containing glass. Final report (January 1981 - February 1985).** Conradt, R.; Roggendorf, H. (Fraunhofer-Institut fuer Silicatforschung (ISC), Wuerzburg (Germany, F.R.)). 11 Mar 1985. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754321/JAW.

The purpose of the reported work was to determine the corrosion behaviour of the inactive HLW glass SM 58 LW 11 in Q-solution at temperatures up to 200/sup 0/C and elevated pressures up to 13 MPa. In particular, a parametric study on the effects of time, temperature, pressure, crystallization, metallic impurities a.o. was performed. Further tests helped to identify the rate determining steps in the entire process and the most likely long-term corrosion law.

50820 **(INIS-mf—11810) Management of radioactive wastes. Abstracts.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1987. 62p. (CONF-8709340—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754658/JAW.

From IAEA interregional training course on management of radioactive wastes; Karlsruhe, F.R. Germany (7 Sep 1987).

The report contains the abstracts of lectures and names and addresses of lecturers and participants.

50821 **(NAGRA-NTB—86-18) Investigations about the suitability of sites for final disposal of low- and intermediate-level radioactive wastes. Overview of the research program for the potential site Piz Pian Grand (communities of Mesocco and Rossa, GR).** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1987. 88p. (In Italian). Nagra, CH-5401 Baden, Switzerland.

On 30th September 1985, the Federal Government licensed site suitability investigations in three areas with a view to disposal of low-and intermediate-level radioactive waste. This report gives a summary overview of the corresponding research programme at the potential site Piz Pian Grand. The first part of the report begins with some comments on the concept of radioactive waste disposal and on some basic aspects of site-specific exploration and investigation. The governmental decision of 30th September and Nagra's two-phase investigation concept are then briefly considered. To close, the objectives of investigation phase 1 are outlined and possible results are briefly discussed. The research programme developed for investigation of the potential site at Piz Pian Grand is presented in the second part of the report. Besides geological and hydrogeological investigations at the surface, the programme mainly comprises investigations and measurements in the free flow tunnel Valbella - Spina of the regional hydroelectric power plant scheme. These include a number of shallow boreholes with specific investigation programmes for recording the characteristics of the crystalline host rock. To find the optimal location of drilling sites geophysical measurements are made which reveal inhomogeneities and discontinuities in the rock. Further sections are devoted to possible additional work and the time-planning of investigation phase 1. The third part of the report gives a brief overview of the most important investigations in the research programmes for the other two potential sites, Bois de la Glaive and Oberbauenstock. (author) 2 figs.

50822 **(NUREG/CR—5092) Progress in evaluation of radionuclide geochemical information developed by DOE high-level nuclear waste repository site projects: Report for April 1986-September 1987.** Meyer, R.E.; Arnold, W.D.; Blencoe, J.G.; O'Kelley, G.D.; Land, J.F. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management; Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 64p. (ORNL/TM—10707). NTIS, PC A04/MF A01 - GPO. Order Number TI88015648/JAW.

Experiments were conducted with tuff from the proposed high-level nuclear waste site at Yucca Mountain, Nevada. Batch sorption ratio determinations were conducted for strontium, cesium, uranium, and technetium onto samples of tuff using real and synthetic groundwater J-13. There were no significant differences in sorption ratios in experiments with real and synthetic groundwater. Columns 1 cm in diameter and about 5 cm long were constructed, and experiments were conducted with the objective of correlating the results of batch and the column experiments. The characteristics of the columns were tested by determination of elution curves in J-13 containing tritium and technetium as the TcO_4^- ion. For strontium and cesium, fairly good correlation between values of the sorption ratio obtained by the two methods was observed. Little or no technetium sorption was observed with either method. The elution peaks obtained with neptunium and uranium were asymmetrical and the shapes were often complex, observations which suggest irreversibilities in the sorption reaction. An experiment was performed to provide information on the compositions of the first groundwaters that will contact waste canisters in a tuff-hosted repository after very near field temperatures have cooled to below 100{degree}C. Synthetic groundwater J-13 was slowly dripped onto a slab of tuff maintained at 95-100{degree}C, and the result was a thin encrustation of solids on the slab as the water evaporated. Fresh J-13 groundwater was then allowed to contact the encrustation in a vessel maintained at 90{degree}C. The principal result of the experiment was a significant loss of calcium and magnesium from the fresh J-13 groundwater.

50823 **(PNL—5577-WV/205) Fabrication and characterization of MCC approved testing material: ATM-WV/205 glass.** Maupin, G.D.; Bowen, W.M.; Daniel, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015522/JAW.

The ATM-WV/205 glass was produced in accordance with PNL's QA Manual for License-Related Programs, MCC technical procedures, and MCC QA Plan that were in effect during the course of this work. The method and procedure to be used in the fabrication and characterization of the ATM-WV/205 glass were specified in two run plans for glass preparation and a characterization plan. The ATM-WV/205 glass meets all specifications. The elemental composition and oxidation state of the glass are within the sponsor's specifications. Visually, the ATM-WV/205 glass bars appear uniformly glassy and generally without exterior features. Microscopic examination and x-ray diffraction revealed low (about 0.5 wt %) concentrations of 3-μm iron chrome spinel crystals and 1-μm ruthenium inclusions scattered randomly throughout the glassy matrix. Closed porosity, with pores ranging in diameter from 20 to 135 μm, was observed in all samples. 3 refs., 10 figs., 21 tabs.

50824 **(PNL—6320-3) LFCM vitrification technology: Qualterly progress report April--June 1987.** Brouns, R.A.; Allen, C.R.; Powell, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 72p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016996/JAW.

This report is compiled by the Nuclear Waste treatment Program and the Hanford Waste Vitrification Program at Pacific Northwest Laboratory to describe the progress in developing, testing, applying and documenting liquid-fed ceramic melter vitrification technology. Progress in the following technical subject areas during the quarter of FY 1987 is discussed: melting process chemistry and glass development; feed preparation and transfer systems, melter systems; and canister filling and handling systems. 4 refs., 20 figs., 18 tabs.

50825 **(PNL—6362) Evaluation of liquid-fed ceramic melter scale-up correlations.** Koegler, S.S.; Mitchell, S.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016997/JAW.

This study was conducted to determine the parameters governing factors of scale for liquid-fed ceramic melters (LFCMs) in order to design full-scale melters using smaller-scale melter data. Results of melter experiments conducted at Pacific Northwest Laboratory (PNL) and Savannah River Laboratory (SRL) are presented for two feed compositions and five different liquid-fed ceramic

melters. The melter performance data including nominal feed rate and glass melt rate are correlated as a function of melter surface area. Comparisons are made between the actual melt rate data and melt rates predicted by a cold cap heat transfer model. The heat transfer model could be used in scale-up calculations, but insufficient data are available on the cold cap characteristics. Experiments specifically designed to determine heat transfer parameters are needed to further develop the model. 17 refs.

50826 **(PNL—6491-3) Description of the Northwest hazardous waste site data base and preliminary analysis of site characteristics.** Woodruff, D.L.; Hartz, K.E.; Triplett, M.B. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016856/JAW.

The Northwest Hazardous Waste RD and D Center (the Center) conducts research, development, and demonstration (RD and D) activities for hazardous and radioactive mixed-waste technologies applicable to remediating sites in the states of Idaho, Montana, Oregon, and Washington. To properly set priorities for these RD and D activities and to target development efforts it is necessary to understand the nature of the sites requiring remediation. A data base of hazardous waste site characteristics has been constructed to facilitate this analysis. The data base used data from EPA's Region X Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) and from Preliminary Assessment/Site Investigation (PA/SI) forms for sites in Montana. The Center's data base focuses on two sets of sites--those on the National Priorities List (NPL) and other sites that are denoted as "active" CERCLIS sites. Active CERCLIS sites are those sites that are undergoing active investigation and analysis. The data base contains information for each site covering site identification and location, type of industry associated with the site, waste categories present (e.g., heavy metals, pesticides, etc.), methods of disposal (e.g., tanks, drums, land, etc.), waste forms (e.g., liquid, solid, etc.), and hazard targets (e.g., surface water, groundwater, etc.). As part of this analysis, the Northwest region was divided into three geographic subregions to identify differences in disposal site characteristics within the Northwest. 2 refs., 18 figs., 5 tabs.

50827 **(PNL-SA—15476) Applications of QA to R&D support of HLW programs.** Ryder, D.E. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 13p. (CONF-880601—44). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014749/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The application of a formal QA program to any discipline or organization can be difficult to achieve and to do so with a research and development organization has special challenges that are somewhat unique. This paper describes how a QA program based upon a national consensus standard (developed for application to the design, construction and operation of nuclear facilities) has been successfully applied to some of the research and development activities in support of the High Level Waste Programs. This description includes a discussion on the importance of being creative when interpreting the QA standard, a brief overview of the QA program that was developed and the results achieved during implementation of the QA program. 4 refs., 4 figs.

50828 **(PSI—11) Chemical behaviour of montmorillonite in a final repository backfill.** Grauer, R. (Paul Scherrer Institut, Wuerenlingen (Switzerland)). (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland). Programm Entsorgung). Jul 1988. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703941/JAW.

With a view to supplementing an earlier report (NTB 86-12, EIR 576), publications appearing in the interim period have been evaluated. Particular emphasis was placed on the thermodynamic status of the clay minerals, the long term stability of montmorillonite and interactions with other repository components. Smectites and illites are presumably thermodynamically unstable and even the formation of metastable solubility equilibria is questionable. Basic problems are thus encountered when formulating equilibrium models for the clay/water interaction. It can be concluded from investigations of argillaceous sediments that, given a repository temperature of 50 to 60 degrees C, a maximum of 50 % of the montmorillonite will alter to illite over a period of around 10/sup 8/ years. The formation of such illite/smectite interstratifications does not impair the function of the backfill material. Since the alteration of calcium montmorillonite is very restricted in comparison with that of the sodium variant, a calcium bentonite should be foreseen as the backfill material. Magnetite is probably unstable in the presence of montmorillonite. The thermodynamic data and experimental results necessary to allow a reliable assessment of potential interactions between the bentonite and the steel canister corrosions products are lacking. Given the current state of knowledge, the formation of iron-rich microcrystalline layer silicates is to be expected. Montmorillonite in contact with alkaline cement pore-waters reacts to form zeolites. This alteration is linked with a volume increase and a loss of plasticity. (author) 127 refs., 31 figs., 4 tabs.

50829 **(SAND—88-7052C) A concrete shaft liner design methodology for nuclear waste repositories.** Richardson, A.M.; St. John, C.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-880654—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015261/JAW.

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

Considerations important to design of cast-in-place concrete liners for repository shafts are discussed. Requirements for repository shaft liners and design criteria appropriate to those requirements are presented. Types of loads acting on a liner and modes of deformation are discussed. Methods are proposed for calculating load magnitudes and liner stresses and for evaluating liner performance. 14 refs., 3 figs.

50830 **(UCRL—21084-Vol.3) Waste minimization summary for LLNL RCRA biennial report 1988: Volume 3.** (Bechtel National, Inc., San Francisco, CA (USA)). 22 Jan 1988. Contract W-7405-ENG-48. 157p. NTIS, PC A08. Order Number DE88016115/JAW.

Data presented herein summarize information found in waste minimization reports presented to the laboratory on December 1986 and July 1987, in the two other reports being presented to the Laboratory at this time, and from other work conducted throughout the course of the contract. Details are included in Section 2, Methodology and Section 3, Regulatory Background. It became obvious that the best approach was to have a standard reporting form which meets the requirements of the RCRA Biennial Report and at the same time address the requirements of both state and federal legislation. As a result, a standard form was created. The use of this form is illustrated in this report by presentation of data for one waste stream. 7 refs., 4 figs., 5 tabs.

50831 (UCRL—53615-86, pp 43-46) **Nuclear waste management.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Nuclear Waste Management Group's primary mission is to manage projects sponsored by the DOE Office of Civilian Radioactive Waste Management (OCRWM) through the Nevada Nuclear Waste Storage Investigations, Salt Repository Project, Repository Technology Program and Basalt Waste Isolation Program offices. The technical activities are carried out jointly with other groups in the Earth Sciences Department, with other divisions and departments at LLNL, and with contractors. The OCRWM program at LLNL comprises three major activities plus support to the DOE in additional areas. These activities are the design and evaluation of a waste package for a tuff repository; the improvement, use and maintenance of the geochemical code, EQ 3/6; and the Spent Fuel Test - Climax. This paper describes activities in waste package research and development, geochemical modeling, the Spent Fuel Test-Climax, and Canadian cooperative technology. A list of recent publications is given. 32 references.

50832 (UCRL—53615-86, pp 57-62) **Geology/geological engineering.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Geology/Geological Engineering Group was created in mid-1986 to apply its expertise in a synergistic way to programs and projects both within and outside the Earth Sciences Department. In a discipline sense, the group expertise embraces rock mechanics; soil mechanics; hydrology; engineering geophysics; and structural, environmental, and economic geology. The group develops and performs in situ and laboratory tests. They provide analysis and numerical simulation to support experiment planning; data analysis and interpretation; and hydrologic, mechanical, and thermal analyses. The data acquisition and management capabilities are important aspects of the Department's technology base through work in data base management, data statistics, geologic exploration and mapping, geotechnical instrumentation, hydrologic instrumentation, remote sensing, site characterization, technical reviews, and well logging. Activities in the following areas are described: civilian radioactive waste management; Defense programs in containment; environmental protection program; Nuclear Regulatory Commission; unconventional gas program; Z-division applied technology and energy security; and BES/continental drilling. A list is given of recent publications. 22 references.

50833 **(WHC-EP—0008-Rev.1) Hanford Waste Vitrification Plant preliminary description of waste form and canister: FY 1988 update.** Mitchell, D.E.; Nelson, J.L. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015592/JAW.

This report focuses on Neutralized Current Acid Waste (NCAW) and describes other wastes in an overview fashion. This description is limited to information pertaining to the physical and chemical characteristics of the expected high-level waste form. The content of the document covers three major areas: waste form characteristics, canister characteristics, and canistered waste form characteristics. The information in this report will be used by the candidate geologic repository project as the basis for preliminary repository design activities and waste form testing. 5 refs., 8 figs., 5 tabs.

50834 **(WHC-EP—0139) Hanford Waste Vitrification Plant Technology Plan.** Sexton, R.A. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88015598/JAW.

The reference Hanford plan for disposal of defense high-level waste is based on waste immobilization in glass by the vitrification process and temporary vitrified waste storage at the Hanford Site until final disposal in a geologic repository. A companion document to the Hanford Waste Management Plan (HWMP) is the Draft, Interim Hanford Waste Management Technology Plan (HWMTP), which provides a description of the technology that must be developed to meet the reference waste management plan. One of the issues in the HWMTP is DST-6, Immobilization (Glass). The HWMTP includes all expense funding needed to complete the Hanford Waste Vitrification Plant (HWVP) project. A preliminary HWVP Technology Plan was prepared in 1985 as a supporting document to the HWMTP to provide a more detailed description of the technology needed to construct and operate a vitrification facility. The plan was updated and issued in 1986, and revised in 1987. This document is an annual update of the plan. The HWVP Technology Plan is limited in scope to technology that requires development or confirmation testing. Other expense-funded activities are not included. The relationship between the HWVP Technology Plan and other waste management issues addressed in the HWMTP is described in section 1.6 of this plan. 6 refs., 4 figs., 34 tabs.

50835 **(WHC-SA—0196) The Grout Treatment Facility: Processing facilities for low-level waste immobilization and disposal.** Guymon, R.H.; Vanselow, L.D.; Campbell, G.D. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 8p. (CONF-880903—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015593/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

In summary, this paper describes the simplified process by which wastes are qualified, how formulations are verified, and how wastes are processed by the GTF and its support facilities for permanent isolation and disposal. Grout treatment involves mixing the low-level fraction of DST wastes with cementitious solids and chemical additives as necessary. The resulting grout slurry is pumped into reinforced concrete vaults located at the near-surface disposal site to cure and solidify. The DST waste is disposed of in batch sizes of approximately 3800 m^3, which is the capacity of the grout feed tank. When the dry solids have been mixed with the liquid waste, the total grout volume is approximately 5300 m^3. The disposal of large monoliths was selected to reduce personnel exposure to radioactive materials and to enhance long-term performance of the final waste form. 3 figs.

50836 **(WHC-SA—0308) Hanford Waste Vitrification Plant quarterly review, second quarter FY 1988.** (Westinghouse Hanford Co., Richland, WA (USA)). May 1988. Contract AC06-87RL10930. 158p. NTIS, PC A08. Order Number DE88013661/JAW.

This report is compiled by the Nuclear Waste Treatment Program and the Hanford Waste Vitrification Program at Pacific Northwest Laboratory to describe the progress in developing, testing, applying and documenting liquid-fed ceramic melter vitrification technology. This document contains only viewgraphs.

50837 **Inhibition of nuclear waste solutions containing multiple aggressive anions.** Congdon, J.W. (E.I. du Pont de Nemours and Co., Savanna River Lab., Aiken, SC (US)). *Materials Performance;* **27**: No. 5, 34-38(May 1988).

The inhibition of localized corrosion of carbon steel in caustic, high-level radioactive waste solutions was studied using cyclic potentiodynamic polarization scans supplemented by partially immersed coupon tests. The electrochemical tests provided a rapid and accurate means of determining the relationship between the minimum inhibitor requirements and the concentration of the aggressive anions in this system. Nitrate, sulfate, chloride, and fluoride were identified as aggressive anions; however, no synergistic effects were observed between these anions. This observation may have important theoretical implications because it tends to contradict the behavior of aggressive anions as predicted by existing theories for localized corrosion.

50838 **Corrosion of radioactive waste tanks containing washed sludge and precipitates.** Bickford, D.F.; Congdon, J.W.; Oblath, S.B. (E.I. du Pont de Nemours and Co., Savanna River Lab., Aiken, SC (US)). *Materials Performance;* **27**: No. 5, 16-21(May 1988).

At the US Department of Energy (DOE) Savannah River Plant, the corrosion of carbon steel storage tanks containing alkaline, high-level radioactive waste is controlled by specification of limits on waste composition and temperature. Laboratory tests, conducted to determine minimum corrosion inhibitor levels, indicated pitting of carbon steel near the waterline for proposed storage conditions. In situ electrochemical measurements of full-scale radioactive process demonstrations were conducted to assess the validity of laboratory tests. The in situ results are compared to those of laboratory tests, with particular regard given to simulated solution composition. Transition metal hydroxide sludge contains strong passivating species for carbon steel. Washed precipitate contains organic species that lower solution pH and tend to reduce passivating films, requiring higher inhibitor concentrations than the 0.01 M nitrite required for reactor fuel reprocessing wastes.

50839 **Acceptance criteria for the development of cementitious waste forms for disposal of selected low-level wastes at Hanford.** Richmond, W.G.; Sams, T.L. (Westinghouse Hanford Co., Richland, WA (USA)). pp 248 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

A key part of the waste management activities at the Hanford Site is disposal of the low-level fraction of radioactive liquid double-shell tank wastes. This waste type, total volume approximately 3 x 10^8 m^3, has been selected for shallow land disposal using

a cement based grout waste form. The development of the formulation for the cementitious materials used to immobilize the waste required that the criteria for an acceptable waste form be developed. The acceptance criteria for the waste form are separated into requirements based on: (1) plant operating limits and (2) disposal system performance. The plant operating limits were determined by a review of proposed plant design criteria. The disposal system performance requirements were developed by reviewing applicable state and federal regulations and by modeling of long-term disposal system performance. The development of the formulation criteria and the methods used to develop formulations that meet the established criteria are discussed.

50840 **Model for acquiring innovative waste immobilization technologies.** Dole, L.R.; Singh, S.P.N. (Oak Ridge National Lab., TN (USA)). pp 250 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

The US Department of Energy's (DOE's) Oak Ridge Operations (ORO) has established the Waste Management Technology Center (WMTC) at Oak Ridge National Laboratory to assist in meeting the environmental requirements for federal facilities as stated in the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The WMTC will bring innovative mixed chemical and radioactive waste treatment and site closure technologies to bear on the many mixed chemical and radioactive waste problems at the DOE-ORO facilities located in Tennessee, Kentucky, and Ohio. The WMTC seeks innovative technologies through a phased procurement cycle that encourages the teaming of emerging technologies with experienced contractors in order to comply with on-site requirements of DOE orders concerning protection of the environment. This three-phase procurement cycle includes: (1) a feasibility study and implementation plan, (2) an on-site pilot demonstration, and (3) full-scale implementation. This paper describes the statements of work for some related demonstrations and remedial actions.

50841 **Electrochemical processing of alkaline radioactive waste solutions.** Hobbs, D.T. (E. I. du Pont de Nemours & Co., Inc., Aiken, SC (USA)). pp 261-264 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

High-level radioactive waste (HLW) is currently stored at the Savannah River Plant in underground carbon steel tanks. The HLW, which is comprised of water soluble (salt solution) and water insoluble (sludge) species, will be processed. This process will concentrate the highly radioactive species as a solid phase for vitrification into a borosilicate glass in the Defense Waste Processing Facility which will eventually be placed in the federal HLW repository. The remaining water soluble species will comprise a low-level liquid waste (LLW). This LLW or decontaminated salt solution will be incorporated into a cement waste form, saltstone, and placed in a lined vault on-site. Off-gas condensate from the melter is a relatively dilute nitrate salt solution which will be recycled to the interim waste storage facilities. This solution is extremely corrosive to carbon steel. Several technologies were considered to decrease levels of hazardous and corrosive species in these solutions and to reduce in volume of liquid waste requiring disposal in saltstone. Electrolytic reduction appeared particularly attractive because of the high nitrate conversion and the potential for significant volume reduction by recycle of the sodium hydroxide. Additional radionuclide decontamination and reduced solution corrosivity may also be realized. Electrochemical separation was investigated because of the potential for recycling both nitric acid and sodium hydroxide at lower electrical energy costs than for the electrolytic reduction process.

50842 **Treatment of ORNL liquid low-level waste.** Berry, J.B.; Brown, C.H. Jr.; Fowler, V.L.; Robinson, S.M. (Oak Ridge National Lab., TN (USA)). pp 265-271 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Discontinuation of the hydrofracture disposal method at Oak Ridge National Laboratory (ORNL) has caused intensive efforts to reduce liquid waste generation. Improving the treatment of slightly radioactive liquid waste, called process waste, has reduced the volume of the resulting contaminated liquid radioactive waste effluent by 66%. Proposed processing improvements could eliminate the contaminated liquid effluent and reduce solid low-level waste by an additional one-third. The improved process meets stringent discharge limits for radionuclides. Discharge limits for radionuclides are expected to be enforced at the outfall of the treatment plant to a creek; currently, limits are enforced at the reservation boundary. Plant discharge is monitored according to the National Pollutant Discharge Elimination System (NPDES) permit for ORNL.

50843 **Burnup credit in the design of spent-fuel shipping casks.** Sanders, T.L.; Westfall, R.M.; Wilmot, E.L. (Sandia National Lab., Albuquerque, NM (USA)). *Transactions of the American Nuclear Society;* **55**: 391-392(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The spent-fuel carrying capacities of previous generation shipping casks have been primarily thermal and/or shielding limited. Shielding and heat transfer requirements for casks designed to transport older spent fuel with longer decay times are reduced significantly. Thus, a considerable weight margin is available to the designer for increasing the payload capacity. One method of achieving an increase in capacity is by reducing fuel assembly spacing. The amount of reduction in assembly spacing available is limited by criticality and fuel support structural concerns. The optimum fuel assembly achievable is then limited by requirements to control neutron multiplication and to ensure the structural integrity of fuel support components. An investigation of the feasibility of accounting for fuel burnup in the design of spent-fuel shipping casks was recently completed for the US Dept. of Energy's Office of Civilian Radioactive Waste Management. Criticality analyses have been performed, and potential impacts in terms of increased cask capacities with associated costs and safety benefits have been determined. The scope of the analysis is limited to typical burnups of full-cycle, discharged pressurized water reactor (PWR) fuel and generic shipping cask designs. A sensitivity analysis was performed to estimate the impact of cask capacity on total transportation system life cycle costs.

50844 **Performance of actinide-containing SRL 165 type glass in unsaturated conditions.** Bates, J.K.; Gerding, T.J. (Argonne National Lab., IL (USA)). pp 651-662 of Scientific basis for nuclear waste management 11: Volume 112: Proceedings. Apted, M.J.; Westerman, R.E. (eds.). Pittsburgh, PA; Materials Research Society (1987). (CONF-8711100—).

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

As part of the effort by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project to evaluate the volcanic tuff beds of Yucca Mountain, Nevada, as a repository for the permanent storage of high-level nuclear waste, the interaction of actinide-doped Savannah River Laboratory (SRL) 165 type glass with the unsaturated repository environment has been studied. The NNWSI Unsaturated Test method has been used, and the results from batch and continuous tests completed through 18 months demonstrate that several interactions are important for controlling both the reaction of the glass and the release of radionuclides. These interactions include (1) the reaction between the glass and moist air with interludes of liquid water contact, which results in the release of alkali metals from the glass; and (2) the reaction between standing water, glass, and presensitized 304 L type stainless steel which results in breakdown of the glass matrix and the release of radionuclides from the glass-metal assemblage. A comparison of the results of the Un-

saturated Test with those of parametric experiments illustrates the importance of presensitized steel in enhancing the glass reaction, and demonstrates the applicability of the Unsaturated Test to those conditions anticipated to exist in the NNWSI repository horizon. 10 references.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 50737, 50749, 50750, 50751, 50752, 50753, 50754, 50755, 50756, 50757, 50758, 50759, 50760, 50761, 50762, 50763, 50764, 50765, 50766, 50767, 50768, 50769, 50770, 50771, 50772, 50773, 50774, 50775, 50776, 50777, 50778, 50779, 50780, 50781, 50782, 50783, 50784, 50785, 50786, 50787, 50788, 50789, 50790, 50791, 50792, 50793, 50799, 50800, 50801, 50802, 50804, 50805, 50806, 50808, 50810, 50812, 50813, 50815, 50816, 50817, 50818, 50819, 50823, 50825, 50826, 50827, 50829, 50833, 50834, 50835, 50836, 50850, 51403, 52109, 52110, 52111, 52112, 52113, 52114, 52128, 52140, 52141, 52166, 52178, 52179

50845 (KAPL—4199) Knolls Atomic Power Laboratory annual environmental monitoring report, calendar year 1987. (Knolls Atomic Power Lab., Schenectady, NY (USA)). 1987. Contract AC12-76SN00052. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88015423/JAW.

The results of the effluent and environmental monitoring programs at the three Knolls Atomic Power Laboratory (KAPL) sites are summarized and assessed in this report. Operations at the three KAPL sites resulted in no significant release of hazardous substances or radioactivity to the environment. The effluent and environmental monitoring programs conducted by KAPL are designed to determine the effectiveness of treatment and control methods, to provide measurement of the concentrations in effluents for comparison with applicable standards, and to assess resultant concentrations in the environment. The monitoring programs include analyses of samples of liquid and gaseous effluents for chemical constituents and radioactivity as well as monitoring of environmental air, water, sediment, and fish. KAPL environmental controls are subject to applicable state and federal regulations governing use, emission and/or disposal of solid, liquid and gaseous materials. Liquid effluents are controlled and monitored in accordance with permits issued by the Connecticut Department of Environmental Protection for the Windsor Site and by the New York State Department of Environmental Conservation for the Knolls and Kesselring Sites. The monitoring data show that KAPL has maintained a high degree of compliance with permit requirements. Chemicals are not manufactured or disposed of at KAPL but are used incidental to site operations. Those substances characterized as hazardous by the Environmental Protection Agency (EPA) are controlled through administrative procedures and personnel training. Small amounts of wastes are generated and disposed of off-site by waste vendors operating under permits issued by the cognizant state and federal regulatory agencies. Handling and storage incident to shipment of wastes is controlled and monitored by trained personnel in compliance with applicable EPA regulations. 38 refs., 11 figs., 36 tabs.

0540 Health And Safety

REFER ALSO TO CITATION(S) 50735, 50736, 50742, 50804, 51734, 51870

50846 (CONF-760202—, pp 206-209) Nuclear energy, radiation and man. Bregar, J.F.; McKlveen, J.W. (Arizona State Univ., Tempe (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Arizona State University, Phoenix Junior College and the Arizona Atomic Energy Commission presented a unique public information seminar designed to acquaint the layman with Nuclear Energy, Radiation and Man. Participants varied from 18 to 70 years in age with educational levels from high school to graduate degrees. In addition to formal classroom lecture, the participants were taken through the Nuclear Medicine Department at a local hospital and the Radiation Research Laboratory at Arizona State University. The last session was devoted to a panel discussion of nuclear problems with participants selected from the class. The discussion was videotaped and later released by a local TV station.

50847 (CONF-760202—, pp 520-522) Operational health physics safeguards during transfer of 38 used Triga fuel elements. Miller, G.E.; Wadman, W.W. III. (Univ. of California, Irvine (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

During the spring of 1974, the University of California, Irvine acquired 38 used Triga fuel elements. The health physics planning of the operation was designed chiefly by the Reactor Supervisor in conjunction with the Radiation Safety Officer. 13 transfer operations of three fuel elements each in a one-inch shielded transfer cask were required to take the elements out of the shipping cask, 70 feet through air, and lowered into a shielded transport cast. The latter was moved under the reactor compartment crane for final transfer to the reactor poll for storage. Radiation levels up to 2.7 roentgens per hour (r/hr) at a meter from the transfer cask were noted. Both Crane Operators served the entire eight-hour shift. The Reactor Crane Operator was often bathed in a 160 mr/hr field. The outside Crane Operator was often exposed at levels up to 80 mr/hr. Exposures as indicated by both body badges during the operation were well below monthly exposure levels, even when radiation exposures from normal reactor operation were added in. Aspects of the handling operation, dry runs, additional shielding, and field dosimetry played a large part in achieving a relatively low exposure to the very few people utilized for this extensive operation.

50848 (CONF-760202—, pp 685-692) Evaluation of operational exposures which could result from potential environmental releases of ^{232}U and daughters. Till, J.E.; Parzyck, D.C. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

This paper provides an evaluation of the potential radiation exposures to man resulting from the operational releases of ^{232}U and daughters from a hypothetical HTGR fuel reprocessing plant. Radionuclides in the source term are ranked according to the magnitude of dose to total body, bone, and lungs for individuals at a distance of 1.5 miles from the stack. Although ^{232}U and daughters account for only 0.1% of the total particulate activity, the total-body dose from these radionuclides is greater in magnitude than the total-body dose from all other radionuclides except ^{134}Cs, ^{137}Cs, and ^{90}Sr. The dose to the lungs from ^{232}U and daughters is greater than that contributed by any radionuclide other than ^{137}Cs and ^{134}Cs. Five radionuclides, ^{90}Sr, ^{137}Cs, ^{134}Cs, ^{238}Pu and ^{244}Cm, deliver a greater dose to bone. An analysis of the volatile releases indicates that if the decontamination factor for ^{220}Rn is between 10^3 and 10^4, the 50-year dose commitment from ^{220}Rn at 1.5 miles will not exceed the dose commitment from the other radionuclides released from the plant. In view of the high radiotoxicity of the ^{232}U present in the recycled ^{233}U HTGR fuel, a comparison is made of the dose commitment to bone resulting from inhalation or ingestion of 1-^{-13} g of either freshly separated HTGR fuel, LMFBR fuel, or LWR fuel.

50849 (CONF-880850—7) Program overview: Remedial actions at Oak Ridge National Laboratory. Bates, L.D.; Trabalka, J.R. (Oak Ridge National Lab., TN (USA)). 27 Jul 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015542/JAW.

From American Institute of Chemical Engineers summer national meeting; Denver, CO, USA (21 Aug 1988).

Research on and development of civilian and defense uses of nuclear materials and technologies have occurred at Oak Ridge National Laboratory (ORNL) since its creation as part of the World War II Manhattan Project in 1943. A diverse legacy of contaminated inactive facilities, research areas, and waste management areas exists; many are candidates for remedial action. Most attention is focused on waste management sites which contain the bulk of ORNL's environmental contamination. A wide variety of liquid and solid wastes, primarily radioactive wastes or mixed wastes in which radioactivity was the principal hazardous constituent, have been disposed of on-site in the past 45 years. One potential approach to remedial problems at ORNL is to design primarily for control and

decay in situ (during an institutional control period of 100 years or more) of intermediate-lived wastes such as ^{3}H, ^{90}Sr, and ^{137}Cs. Passive measures designed to provide greater long-term confinement (for example, in situ vitrification) could be exercised at sites contaminated with TRU wastes or high concentrations of hazardous constitutes. This approach would (a) provide a period sufficiently long for evaluation of the effectiveness of environmental processes and passive remedial measures in controlling the migration of long-lived materials, (b) allow additional time needed for development of new technologies for more permanent site stabilization, and (c) reduce the need for immediate implementation of the more-expensive exhumation and disposal option.

50850 **(DOE/EH—0061) Technical safety appraisal: Buildings 776/777 Rocky Flats Plant.** Field, H.C. (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety). Mar 1988. 277p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88016374/JAW.

Buildings 776/777 at the Rocky Flats Plant are major components of the production complex at the plant site. They have been in operation since 1957. The operations taking place in the buildings are nuclear weapons production support, processing of weapons assemblies returned from Pantex, waste processing, research and development in support of production, special projects, and those generated by support groups, such as maintenance. The appraisal team identified nine deficiencies that it believed required prompt attention. DOE management for EH, the program office (Defense Programs), and the field office analyzed the information provided by the appraisal team and instituted compensatory measures for closer monitoring of contractor activities by knowledgeable DOE staff and staff from other sites. Concurrently, the contractor was requested to address both short-term and long-term remedial measures to correct the identified issues as well as the underlying problems. The contractor has provided his action plan, which is included. This plan was under evaluation by EH and the DOE program office at the time this report was prepared. In addressing the major areas of concern identified above, a well as the specific deficiencies identified by the appraisal team, the contractor and the field office are cautioned to search for the root causes for the problems and to direct corrective actions to those root causes rather than solely to the symptoms to assure the sustainability of the improvements being made. The results of prior TSAs led DOE to conclude that previous corrective actions were not sufficient in that a large number of the individual findings are recurrent. Pending completion of remedial actions over the next few months, enhanced DOE oversight of the contractor is warranted.

50851 **(DOE/UMT—8015375) Technical approach document.** (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). Apr 1988. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88015375/JAW.

This document describes the general technical approaches and design criteria adopted by the US Department of Energy (DOE) in order to implement Remedial Action Plans (RAPs) and final designs that comply with EPS standards. This document is a revision to the original document. Major revisions were made to the sections in riprap selection and sizing, and ground-water; only minor revisions were made to the remainder of the document. The US Nuclear Regulatory Commission (NRC) has prepared a Standard Review Plan (NRC-SRP) which describes factors to be considered by the NRC in approving the RAP. Sections 3.0, 4.0, 5.0, and 7.0 of this document are arranged under the same headings as those used in the NRC-SRP. This approach is adopted in order to facilitate joint use of the documents. Section 2.0 (not included in the NRC-SRP) discusses design considerations; Section 3.0 describes surface-water hydrology and erosion control; Section 4.0 describes geotechnical aspects of pile design; Section 5.0 discusses the Alternate Site Selection Process; Section 6.0 deals with radiological issues (in particular, the design of the radon barrier); Section 7.0 discusses protection of groundwater resources; and Section 8.0 discusses site design criteria for the RAC.

50852 **Criticality experiments with dilute plutonium-uranium nitrate solution at plutonium fractions of 0.2 and 0.5 in cylindrical geometry.** Lloyd, R.C.; Matsumoto, T. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **55**: 377-378(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The objective of these experiments is to obtain data on the minimum fissil concentration for criticality from measurements on a large (low neutron leakage) cylindrical vessel. The limiting concentration is fundamental data unique to the particular fuel mixture studied and is important for criticality control. Prior to these measurements, no data existed concerning the effect of dissolved uranium on the minimum critical concentration of plutonium. These data can be applied whenever mixtures of plutonium and uranium exist, in the head end of a fuel reprocessing plant through the first solvent extraction cycle, in storage vessels, and during product conversion when a coprocessing scheme is used. A series of critical experiments was completed in large cylindrical geometry with mixed plutonium-uranium solutions with a water reflector. The concentrations were 22 and 53 g (Pu + U)/l with a plutonium-to-total-heavy-metal (HM) ratio (plutonium plus uranium) of 0.52 or 0.23, respectively. These experiments were a part of the Criticality Data Development Program between the US Department of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan.

50853 **Fission rate measurements at the vessel/reflector interface of a dilute plutonium-uranium nitrate solution in cylindrical geometry.** Bierman, S.R.; Fukumura, N. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **55**: 378-380(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

As part of the Criticality Data Development Program between the US Dept. of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation of Japan, neutron reaction rate measurements are being made on selected critical assemblies at the DOE Hanford Critical Mass Laboratory. Fission rate measurements made on the surface of a large water-reflected cylinder of plutonium-uranium nitrate solution are presented.

50854 **Validation studies performed with low-concentration mixed Pu + U aqueous critical experiments.** Smolen, G.R.; Funabashi, H. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 380-381(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The results of a calculational study that was performed to validate the SCALE-2 computer code system using data from critical experiments performed with low concentrations of mixed Pu + U aqueous solutions are discussed. Also, fission rates were calculated and compared with measured data that were obtained with solid-state track recorders (SSTRs). These experimental activities (subtask 110) are part of a joint exchange program between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan in the area of criticality data development. The experiments were conducted at the Battelle Pacific Northwest Laboratories Critical Mass Laboratory. The purpose of the experiments was to provide benchmark data for dilute Pu + U aqueous solutions where the criticality control parameter limiting critical concentration is appropriate. The limiting critical concentration for ^{239}Pu in nitric acid is $\sim$ 7.3 g/l. In fuel recycle facilities, plutonium is mixed with acid and often with uranium. In the presence of uranium, the limiting critical concentration can be expected to be higher, which would allow more economical subcritical limits to be used.

50855 **Validations with critical experiments using aqueous ^{235}U in an annular tank.** Tanner, J.E. *Transactions of the American Nuclear Society;* **55**: 381-382(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Seventeen critical experiments employing an aqueous uranyl nitrate solution, 303 g U(93.0%)/l, in an annular tank were performed, with internal annular absorbers of polyethylene and/or stainless steel and/or an external annual reflector of carbon steel. Critical solution heights were determined by extrapolation of neutron multiplications as the height was increased. The o.d. of the solution annulus was 75 cm, and it was 8.92 cm thick. Modeling of the experiments with the Monte Carlo codes KENO-IV and MONK 6.2, and with the one-dimensional XSDRNPM transport code is reported here.

50856 New interactive CESAR. Fox, P.B.; Yatabe, M. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 385(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Nuclear Criticality Safety Analytical Methods Resource Center announces the availability of a new interactive version of CESAR, a critical experiments storage and retrieval program available on the Nuclear Criticality Information System (NCIS) data base at Lawrence Livermore National Laboratory. The original version of CESAR did not include interactive search capabilities. The CESAR data base was developed to provide a convenient, readily accessible means of storing and retrieving code input data for the SCALE criticality safety analytical sequences and the codes comprising those sequences. The data base includes data for both cross-section preparation and criticality safety calculations.

50857 Separability approximation and its application to S/sub n/. Clark, H.K. *Transactions of the American Nuclear Society;* **55**: 385-387(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Although nuclear criticality safety analysis are commonly performed by a Monte Carlo computer code such as KENO, one-dimensional determinate methods still play an important role. These methods are useful for rapid surveys, for detecting errors in Monte Carlo results by analyzing simplified configurations, and for analyzing configurations that are essentially simple. The usefulness of these methods is greatly enhanced where separability of the neutron flux into axial and radial components, for example, is a good approximation. With two-group diffusion theory this procedure is straight-forward. Application to transport theory in an S/sub n/ code such as ANISN is more complicated. As a test of the procedure outlined here, a number of calculations were performed for a set of water-reflected cylinders of 400-g $^{233}U/l$ solution calculated to be critical by TWO-TRAN with two-group cross sections derived from ENDF/B-IV. Results are given and show the procedure to be a good approximation. Care must be taken, however, in incorporating this procedure into an S/sub n/ code. Replacing diffusion constants in aluminum with constants calculated by SLICE gives significant improvement.

50858 Criticality of spent reactor fuel. Harris, D.R. *Transactions of the American Nuclear Society;* **55**: 396-397(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The storage capacity of spent reactor fuel pools can be greatly increased by consolidation. In this process, the fuel rods are removed from reactor fuel assemblies and are stored in close-packed arrays in a canister or skeleton. An earlier study examined criticality consideration for consolidation of Westinghouse fuel, assumed to be fresh, in canisters at the Millstone-2 spent-fuel pool and in the General Electric IF-300 shipping cask. The conclusions were that the fuel rods in the canister are so deficient in water that they are adequately subcritical, both in normal and in off-normal conditions. One potential accident, the water spill event, remained unresolved in the earlier study. A methodology is developed here for spent-fuel criticality and is applied to the water spill event. The methodology utilizes LEOPARD to compute few-group cross sections for the diffusion code PDQ7, which then is used to compute reactivity. These codes give results for fresh fuel that are in good agreement with KENO IV-NITAWL Monte Carlo results, which themselves are in good agreement with continuous energy Monte Carlo calculations. These methodologies are in reasonable agreement with critical measurements for undepleted fuel.

50859 Modeling of criticality accidents and their environmental consequences. Thomas, W.; Gmal, B. *Transactions of the American Nuclear Society;* **55**: 409-410(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In the Federal Republic of Germany, potential radiological consequences of accidental nuclear criticality have to be evaluated in the licensing procedure for fuel cycle facilities. A prerequisite to this evaluation is to establish conceivable accident scenarios. First, possibilities for a criticality exceeding the generally applied double contingency principle of safety are identified by screening the equipment and operation of the facility. Identification of undetected accumulations of fissile material or incorrect transfer of fissile solution to unfavorable geometry normally are most important. Second, relevant and credible scenarios causing the most severe consequences are derived from these possibilities. For the identified relevant scenarios, time-dependent fission rates and reasonable numbers for peak power and total fissions must be determined. Experience from real accidents and experiments (KEWB, SPERT, CRAC, SILENE) has been evaluated using empirical formulas. To model the time-dependent behavior of criticality excursions in fissile solutions, a computer program FELIX has been developed.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 51243

50860 (BNL—41488) Means for meeting the MC and A performance requirements of DOE Order 5633.3. Kane, W.R.; Keisch, B.; Sanborn, J.B.; Suda, S.C. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880631—47). NTIS, PC A02. Order Number DE88015199/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

DOE Order 5633.3, Control and Accountability of Nuclear Materials, includes specific performance requirements that a facility's safeguards system must meet. The performance criteria specify the ability of the system to detect the loss of a given quantity of material in terms of a detection probability and a time to detection. In order to determine that a facility meets the performance requirements of the Order, quantitative evaluation techniques must be developed which can be applied uniformly and objectively to DOE facilities. Methods by which a facility may evaluate its program against the performance criteria of the Order and by which the field office may conduct review and oversight of the facility's program have been developed. They have been incorporated into two guides for the use of the facilities and field offices respectively. 3 refs., 1 fig.

50861 (BNL—41513) Methods for cost-benefit-risk analysis of material-accounting upgrades. Fishbone, L.G.; Gordon, D.M.; Higinbotham, W.; Keisch, B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-880631—49). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015859/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

We have developed a cost-benefit-risk methodology for evaluating material-accounting upgrades at key measurement points in nuclear facilities. The focus of this methodology is on nuclear-material measurements and their effects on inventory differences and shipper/receiver differences. The methodology has three main components: Cost, Benefits, and Risk. The fundamental outcome of the methodology is therefore cost-benefit ratios characterizing the proposed upgrades, with the risk factors applied as necessary to the benefits. Examples illustrate the methodology's use. 10 refs., 3 figs., 6 tabs.

50862 **(BNL-NUREG—451454) A strategy for examining human reliability aspects of plant security.** O'Brien, J.N.; Luckas, W.J. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-880633—6). NTIS, PC A02. Order Number DE88013996/JAW.

From 4. international conference on human factors and power plants; Monterey, CA, USA (5 Jun 1988).

This paper presents a strategy for developing a long-term research plan for human factors issues which can adversely affect safeguards at nuclear power plants. It was developed in order to prioritize and propose research for appropriately addressing nuclear power plan safeguards needs. The strategy consists of a series of parts, the first of which identifies and ranks human factors issues affecting the quality of nuclear power plant safeguards in terms of their importance. The second part involves determining the feasibility of conducting research in the areas found to be important to nuclear power plant safeguards. Third, research efforts are then developed and prioritized into main program elements according to the importance of human factors issue areas derived in the first part and the feasibility of research determined in the second part. From this strategy, a realistic overall long-term research plan will emerge.

50863 **(CEA-IPSN-RA—1987) IPSN Progress Report 1987.** (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). 1987. 151p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754939/JAW.

Activity report of the Nuclear Safety and Protection Institute (IPSN).

50864 **(LA-UR—88-1930) The second US/FRG workshop on near-real-time accounting for reprocessing plants.** Hakkila, E.A.; Gutmacher, R.G.; Weh, R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880631—38). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014444/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

The second technical workshop on near-real-time accounting in an industrial scale reprocessing plant was held from December 7–9, 1987 in Los Alamos. The workshop was organized within the context of the US/DOE–FRG/BMFT agreement in the field of international safeguards. The workshop was initiated by the Los Alamos National Laboratory and the DWK, which has responsibility for construction and operation of a planned industrial scale reprocessing plant in the FRG. The workshop objective was to review current state-of-the-art in the near-real-time accounting and to develop a common understanding among experts from the participating countries to identify problems requiring additional work.

50865 **(UCRL—98888) Development of performance tests for an automated MC and A system.** Kok, K.D.; Klingensmith, R.W.; Riffle, W.; Carver, R.D.; Schumacher, S.S.; Byers, K.R.; Lavender, J.C.; Smith, B.W. (Lawrence Livermore National Lab., CA (USA)). 19 May 1988. Contract W-7405-ENG-48. 10p. (CONF-880631—27). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013807/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

Performance tests of MC&A systems using computers are described, and some example scenarios are discussed. Facility personnel or an external inspection group may use performance tests to evaluate MC&A Capabilities under actual operating conditions. This paper addresses test elements common to both user groups. Performance tests consist of scenario development, security and safety measures, conduct, and evaluation. Because exercises often test scenarios against which the MC&A system is protecting, they may require additional security and safety measures. Computer systems enhance MC&A by providing greater speed, increased precision, and automated checks. performance tests for MC&A systems using computers differ from performance tests employing manual data systems in that the scenarios must anticipate computer actions rather than utilize controllers to adjust the scenario.

50866 **(WHC-SA—0002) EMCAS: An evaluation methodology for safeguards and security systems.** Eggers, R.F.; Giese, E.W.; Bichl, F.J. (Westinghouse Hanford Co., Richland, WA (USA)). 1987. Contract AC06-87RL10930. 10p. (CONF-870713—62). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014612/JAW.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

EMCAS is an evaluation methodology for safeguards and security systems. It provides a score card of projected or actual system performance for several areas of system operation. In one area, the performance of material control and accounting and security systems, which jointly defend against the insider threat to divert or steal special nuclear material (SNM) using stealth and deceit, is evaluated. Time-dependent and time-independent risk equations are used for both diversion and theft risk calculations. In the case of loss detection by material accounting, a detailed timeliness model is provided to determine the combined effects of loss detection sensitivity and timeliness on the overall effectiveness of the material accounting detection procedure. Calculated risks take into account the capabilities of process area containment/surveillance, material accounting mass balance tests, and physical protection barriers and procedures. In addition, EMCAS evaluates the Material Control and Accounting (MC and A) System in the following areas: (1) system capability to detect errors in the official book inventory of SNM, using mass balance accounting methods, (2) system capability to prevent errors from entering the nuclear material data base during periods of operation between mass balance tests, (3) time to conduct inventories and resolve alarms, and (4) time lost from production to carry out material control and accounting loss detection activities. 3 figs., 5 tabs.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 50851, 51168

50867 **(INIS-BR—1233) Juridical and institutional aspects of radioactive wastes.** Faria, N.M. de. (Rio de Janeiro Univ. (Brazil)). Jul 1988. 318p. (In Portuguese). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704120/JAW.

The author proposes a discussion of a new branch of the public law - the nuclear law. The main subject is the radioactive waste. Its production is a decisive problem in the utilization of nuclear energy being one of the discussed questions from the technical, economical, political, social and juridical points of view. Countries have been striving to establish their own policies related to radioactive wastes having always in mind the man and the environmental protection. In this scenario the author developed the investigations trying to discuss juridical and institutional aspects of radioactive wastes on the international level as well as in different countries with the aim to establish the juridical basis of a radioactive wastes policy in Brazil.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 51240

50868 **(DOE/EH—0066) Technical Safety Appraisal of the T-Building, Mound Plant.** (USDOE, Washington, DC). Apr 1988. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88010963/JAW.

This report presents the results of one in a series of Technical Safety Appraisals of DOE's nuclear operations being conducted by the Assistant Secretary for Environment, Safety, and Health's Office of Nuclear Safety. This Technical Safety Appraisal of the T-Building tritium operations at the Mound Plant was conducted from October 19 to 23, and from November 2 to 13, 1987. The purpose of the Technical Safety Appraisal Program is to evaluate and strengthen DOE's nuclear operations by verifying contractor com-

pliance with DOE Orders, to assure that lessons learned from commercial nuclear operations are incorporated into facility operations, and to stimulate and encourage pursuit of excellence; thus, the appraisal addresses more issues than would be addressed in a strictly compliance-oriented appraisal. The team's evaluation is guided by a set of pre-established Performance Objectives have been addressed by this appraisal in 13 subject areas. These 13 areas are: organization and administration, operations, maintenance, training and certification, auxiliary systems, emergency readiness, technical support, security/safety interface, experimental activities, facility safety review, radiological protection, personnel protection, and fire protection.

50869 (JAERI-M—88-065, pp 238-242) **Free-electron laser: brief review and topics.** Kawarasaki, Yuuki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The birth and the recent topics of FEL researches are briefly reviewed in connection with the change of a research objective.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 52021, 52209

50870 (BNL—39428, pp C5) **Clinical facility for measuring total body fat.** Oxby, C.B.; Burkinshaw, L.; Oldroyd, B. (Univ. of Leeds (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The paper reviews the progress in the development, design and installation of a clinical facility for measuring the amounts of fat and other body components using the techniques of prompt and delayed in vivo neutron activation analysis. Fat is measured during the neutron irradiation by counting the 4.43 MeV gamma rays from carbon nuclei excited by neutron inelastic scattering. The system consists of a 14 MeV neutron generator in a shielded enclosure with a collimator forming a horizontal beam of neutrons incident upon a lateral side of a supine patient. Collimated 6″ x 5″ NaI detectors are positioned two above and three below the subject in a mid-saggital plane. The gamma radiations resulting from neutron interaction with the body's hydrogen, carbon and oxygen are clearly observed in the detectors' response and those counts from carbon are used to estimate total body fat. After a neutron irradiation the subject is transferred to a whole body radiation counter consisting of eight 6″ x 4″ NaI detectors and their response resulting from the radioactivity induced in the body by the neutron irradiation is analyzed to give estimates of total body nitrogen, phosphorus, sodium, chlorine and calcium. Accuracy and precision of the measurements will be reported.

50871 (BNL—39428, pp P1) **Anthropomorphic models for the calibration of equipment for in vivo neutron activation analysis.** Bewley, D.K. (Hammersmith Hospital, London (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

At present each laboratory performing chemical analysis in vivo calibrates its equipment with home-made anthropomorphic models containing the elements of interest. These models are of varying construction, usually contain only one element at a time, and often approximate poorly to human anatomy and its variation. To improve on this state of affairs the author has constructed 3 models of the human body of different sizes. Miss Small and Mr. Average are made up of circular or elliptic cylinders with walls of Polythene, polypropylene or Perspex. Mr. Big is modeled on an actual person and is made of transparent plastic. The bony skeletons are Perspex tubes filled with various chemicals, mainly calcium phosphate. The tibias of Mr. Average contained lead. The bony anatomy is severely simplified; for example, the ribs run longitudinally and the lower legs and arms contain only a single bone in each. Each model contains thyroid, lungs, liver and kidneys. Thyroids contain only iodine. Lungs have densities of about 0.3 and Miss Small's lungs contain silicon. Measurements can be made either of total body contents or of the quantities of trace elements in individual organs.

50872 (BNL—39428, pp P7) **Design and construction of a new instrument for multi-elemental IVNAA.** Ryde, S.J.S.; Morgan, W.D.; Sivyer, A.; Evans, C.J.; Dutton, J. (Univ. College of Swansea, Wales (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

A new instrument for the in vivo analysis of major and minor body elements has been designed and built for clinical studies within a General Hospital. The design objectives were to provide a system capable of measuring primarily calcium, nitrogen, and cadmium in a manner, and at a cost, which would not preclude a wider utilization of the technique. The choice of a ^{252}Cf neutron source, a pneumatic source transport system and a scanning couch geometry have fulfilled these objectives and produced a system which can operate in three modes, viz prompt, delayed and cyclic activation.

50873 (BNL—39428, pp P8) **New multi-elemental analysis system using ^{252}Cf: calibration and performance.** Ryde, S.J.S.; Morgan, W.D.; Evans, C.J.; Sivyer, A.; McNeil, E.; Sandhu, S. (Univ. College of Swansea, Wales (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

A new neutron activation system has been designed and constructed within the clinical environment of a General Hospital. A 4.0 GBq ^{252}Cf neutron source may be pneumatically driven to one of two irradiation ports, each of which is wide enough to achieve a total-body measurement when the subject is scanned from head-to-toe across the aperture. Alternatively, collimator inserts can reduce the aperture to a size suitable for partial-body measurements. A novel feature of this system is the ability to measure total-body calcium by the prompt-gamma technique using large volume (100 cm^3) HpGe detectors. Preliminary results using phantoms have shown that TBCa can be measured to a precision of 2.8% for a total body dose equivalent of 5mSv, assuming a QF of 10 for fast neutrons. This compares favorable with the performance of the delayed technique, particularly when it is noted that the prompt-gamma method can provide a profile of the distribution of calcium along the length of the body. In addition, the measurement of other elements such as nitrogen, hydrogen and chlorine is achieved simultaneously. The instrument is also capable of measuring other trace and toxic elements such as cadmium iron, copper, aluminum and selenium, the last two by a cyclic activation method for which particular attention has been paid to the choice of neutron source, source transport system, and control electronics.

50874 (BNL—39428, pp P15) **In vivo calcium determination of small samples using ^{252}Cf neutron activation facility.** Krishnan, S.S.; Song, J.; Bayley, M.T.; Lin, S.C.; Hitchman, A.J.W.; Harrison, J.E. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

An in vivo neutron activation analysis (IVNAA) facility is required to measure calcium content of hands, since it is felt that, in certain diseases such as renal osteodystrophy, the bone is preferentially lost from the hand rather than the central skeleton. In addition it is also required for animal experiments such as with rats. This paper describes the design and details of such a facility. The neutron flux in the irradiation chamber is fairly uniform and errors due to the movement of samples within it is +/- 1.2% which is within counting statistics. The effect of variations in sample size is -4.85% for 100 ml increase in volume. The reproducibility of the measurement of a 3g calcium aqueous standard is +/- 4% most of

which is due to counting statistics. A series of animal experiments done on this facility and compared with atomic absorption analysis of the total bone after sacrificing the animals show that the average difference in the values is 4.6% +/- 3.7% (S.D.) for animals over 150 g body weight. The paper also reports results of correlation studies of central skeletal calcium by IVNAA vs hand calcium in volunteers and untreated osteoporotics.

50875 **(CNIC—00095) Intercomparison of measurements for the thickness of the ultra thin sources and the deposited films.** Du Hongshan; Liang Dongqi; Wang Yusheng. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 5p. (In Chinese). (IAE—0028). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704095/JAW.

Intercomparison of measurements for the thickness of the ultra thin sources and the deposited films prepared by vacuum evaporation method has been made by means of the gravimetric, the electron spectrometric analysis and the backscattering methods respectively. The results agree with the values obtained with the quartz-crystal micro-balance of Model SF-3. It is proved that quartz-crgstal micro-balance of Model SF-3 is a reliable tool for the thickness measurements of the ultra thin sources and the deposited films prepared with the vacuum evaporation technique.

50876 (CONF-760202—, pp 486-488) **Shielding design and construction for a three unit, flash (pulsed) X-ray machine facility.** Wadman, W.W. III. (Univ. of California, Irvine (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Pulsed or flash x-ray machine facilities are not particularly common to university campuses. The University of California, Irvine (UCI) has designed a facility to accommodate a 480 KVP, and an 1100 KVP unit, and space for a unit to be designed and built at UCI with a variable KVP from 750 - 2200. The current of each of these devices is 80,000; 140,000; and 100,000 - 200,000 amperes per pulse, respectively. The pulse durations are all on the order of 5×10^{-8} seconds. The facility was to be designed to fit an already existing room, which had some advantageous and disadvantageous features regarding this type of usage. Various levels specified by guidelines with regard to personnel exposure at boundaries of an uncontrolled area, some non-radiation details with regard to oil storage tanks as promolgated by EPA, and the asthetic demands of the Campus Architectural Committee all had to be satisfied. The radiation shielding calculations are discussed as are non-radiation aspects which went into making this facility acceptable by the regulatory agencies, campus architect, and researcher. Finally, the program requirements, such as safety equipment to be installed, monitoring devices to be utilized, and types of dosimetry equipment, were all planned for and are detailed. A schematic diagram of the planning operations of this facility is also described.

50877 (CONF-760202—, pp 539-547) **Design and construction of a universal safety interface for use with industrial X-ray inspection systems.** Piltingsrud, H.V.; Stencel, J.R. (Radiological Health Laboratory (AFLC), Wright-Patterson Air Force Base, OH (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Serious problems related to technical sufficiency and costs have been encountered when design and construction of industrial X-ray safety circuits have been left up to each individual X-ray facility. The device described herein is an attempt to provide a general solution to this problem. It appears to satisfy all present and anticipated standards and guidelines related to industrial X-ray safety circuits.

50878 **(CONF-881011—12) Radiation transport calculations for the ANS [Advanced Neutron Source] beam tubes.** Engle, W.W., Jr.; Lillie, R.A.; Slater, C.O. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012487/JAW.

From Joint meeting of the European Nuclear Society and the American Nuclear Society; Washington, DC, USA (30 Oct 1988).

The Advanced Neutron Source facility (ANS) will incorporate a large number of both radial and no-line-of-sight (NLS) beam tubes to provide very large thermal neutron fluxes to experimental facilities. The purpose of this work was to obtain comparisons for the ANS single- and split-core designs of the thermal and damage neutron and gamma-ray scalar fluxes in these beams tubes. For experimental locations far from the reactor cores, angular flux data are required; however, for close-in experimental locations, the scalar fluxes within each beam tube provide a credible estimate of the various signal to noise ratios. In this paper, the coupled two- and three-dimensional radiation transport calculations employed to estimate the scalar neutron and gamma-ray fluxes will be described and the results from these calculations will be discussed. 6 refs., 2 figs.

50879 **(GSF—2/88) DIN standards part 2, concerning the industrial and technical applications of ionizing radiation.** Loester, W.; Kraft, A. (comps.). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Jan 1988. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754645/JAW.

The DIN standards listed refer to the field of metrology, describing measuring equipment, radiological protection measures and equipment, decontamination, and to the field of nondestructive testing. DIN standards for medical applications are included in case of significance for technical applications. Unfortunately there is no subject heading index.

50880 **(IAEA-TECDOC—465) Isotopic neutron sources for neutron activation analysis.** Hoste, J. (Ghent Rijksuniversiteit (Belgium)). (International Atomic Energy Agency, Vienna (Austria)). Jun 1988. 113p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704117/JAW.

This User's Manual is an attempt to provide for teaching and training purposes, a series of well thought out demonstrative experiments in neutron activation analysis based on the utilization of an isotopic neutron source. In some cases, these ideas can be applied to solve practical analytical problems. 19 refs, figs and tabs.

50881 **(INIS-mf—11296) Evaluation of some ancient metal and clay artifacts by the radiography technique.** Tugrul, B.; Sungur, F.; Mericboyu, Y.; Yildiz, F. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy; Archaeological museums of Istanbul). (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1986. 14p. (In Turkish). (CONF-8605344—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703914/JAW.

From 8. excavation research and archaeometry symposium; Ankara, Turkey (26 May 1986).

X-ray radiography and betagraphy which are applied on different archaeological artifacts have been given including some general information about the technique. A study was realized on a chunk of beads and a disc which can not be noticed by visual inspection, clustered together. The x-ray radiography of the cluster disclosed that the disc has cuneiform script on it which is assigned to the period of Assyrian King Shalmaneser I. The other two studies were realized on the metal artifacts an armour and latch. Furthermore, betagraphy was applied an armour cloth. X-ray radiography was applied on tablets in spite of the limitations of the technique. Further infotmation were obtained about on enveloped letter tablets. Therefore, the radiographic evaluation can be easy and nondestructively which is impossible otherwise.

50882 (INIS-mf—11297) Investigation of some ancient opaque glasses in the archaeological museums of Istanbul by x-ray radiography technique. Tugrul, B.; Sungur, F.; Atik, S. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy; Archaeological museum of Istanbul). (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1986. 9p. (In Turkish). (CONF-8605344—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703915/JAW.

From 8. excavation research and archaeometry symposium; Ankara, Turkey (26 May 1986).

In this study, opaque glass samples of which interiors is invisible, investigated by the x-ray radiography technique. In the evaluation,some knowledge has been extracted about the glass base and mold technique. Furthermore,it was shown that ornamental attachments have been fixed on the glass artifacts by techniques different than what it appears to be. In addition to that, joining edges of restorated opaque glass samples can be investigated and quality of the restoration can be evaluated. Therefore, the opaque glass samples were investigated non-destructively a short period of time, much like transparent glass could be studied.

50883 (KURRI-TR—291, pp 16-19) Negative ion source with LaB/sub 6/. Imanishi, Nobutsugu. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

The author has been engaged in the development of a high-efficiency, surface-ionization type negative ion source that employs LaB/sub 6/ to measure halogens resulting from nuclear fission and offgas from reprocessing facilities. The equipment presented previously has recently improved greatly so that it can be applied to ionization of various ions and study on microscopic mechanisms of ionization caused by surface reactions. The improved equipment is used to investigate the ionization process of iodine. Solid iodine is heated and gasified iodine is introduced into the LaB/sub 6/ ionizer. Negative ions produced are taken out by imposing a voltage, accelerated, converged and subjected to ion current intensity measurement. With the iodine ion current maintained constant, the temperature of the LaB/sub 6/ is changed while the intensity of the negative iodine ion beam is measured at an imposed voltage of 0.3, 0.5 or 0.8 kV. The ion current increases exponentially with the ionizer temperature and then decreases after reaching a maximum at a certain temperature. The maximum is higher at higher voltages. Next, as the temperature is decreased, the curve shows higher current values than those observed during the heating process, indicating that temperature hysteresis is taing place. The temperature hysteresis is explained in terms of the processes of adsorption to the surface of the ionizer, diffusion over the surface and desorption as negative ions or neutral atoms. (Nogami, K.).

50884 Diffusion theory model for optimization calculations of cold neutron sources. Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 343-344(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Cold neutron sources are becoming increasingly important and common experimental facilities made available at many research reactors around the world due to the high utility of cold neutrons in scattering experiments. The authors describe a simple two-group diffusion model of an infinite slab LD_2 cold source. The simplicity of the model permits to obtain an analytical solution from which one can deduce the reason for the optimum thickness based solely on diffusion-type phenomena. Also, a second more sophisticated model is described and the results compared to a deterministic transport calculation. The good (particularly qualitative) agreement between the results suggests that diffusion theory methods can be used in parametric and optimization studies to avoid the generally more expensive transport calculations.

0704 Economics

50885 (PNL—6657) List of DOE radioisotope customers with summary of radioisotope shipments, FY 1987. Lamar, D.A.; Van Houten, N.C. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016857/JAW.

This edition of the radioisotope customer list was prepared at the request of the Office of Health and Environmental Research (ER-73), Office of Energy Research, US Department of Energy (DOE). This document describes radioisotope distribution from DOE facilities to private firms, including foreign and other DOE facilities. The information is divided into five sections: 1) isotope suppliers, facility contact, and isotopes or services supplied; 2) customers, suppliers, and isotopes purchased; 3) isotopes purchased cross- referenced with customer numbers; 4) geographic locations of radioisotope customers; and 5) radioisotope sales and transfers for fiscal year 1987.

08 HYDROGEN

50886 (BEI—7512) A quantitative and qualitative study on hydrogen as a component of the national energy base. (Biomass Energy Inst., Inc., Winnipeg, Manitoba (Canada)). 15 Dec 1975. vp. (CE—01863). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report reviews Canada's energy base, both in terms of supplies, consumption, and magnitude. It is felt that the expansion of the energy resource base, both renewable and non-renewable, cannot occur without increased utilization of hydrogen. The report presents the current situation of hydrogen production and consumption in Canada, and contains an incomplete list of potential applications of hydrogen. Some are based on development opportunities unique to Canada while others are more general in nature. Technical problems of hydrogen development and alternatives to hydrogen use are also examined with the view that energy decisions should be made on a case-by-case basis. For example, where a carbon source is easily accessible, methane may be a better choice than hydrogen. The issue of whether a hydrogen-based economy would be consistent with national goals is examined. One idea is that future energy needs will be satisfied by a small number of energy forms; hydrogen is a possible type of common energy distribution medium that would appear to be in Canada's best interest. In analyzing this question, it is possible that technical and economic assumptions can overly enhance certain alternatives at the expense of others. For example, ignoring the by-products of electrolysis of water may have a negative impact on the perceived economics of that method of hydrogen production. It is certain that hydrogen, by itself or after reaction with carbon, will play a vital role in Canada's energy future, particularly if a diverse energy system is chosen on a case-by-case basis, a scenario which seems to be consistent with present government policy. Includes subject index. 96 refs., 11 figs., 33 tabs.

50887 (EFN—25) Hydrogen - a future energy carrier. Oesterberg, C.J. (3K Engineering AB, Stockholm (SE)). (Energiforskningsnaemnden, Stockholm (Sweden)). Mar 1987. 224p. (In Swedish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88754396/JAW.

There is very little present-day use of hydrogen as an energy carrier. Hydrogen is formed as a by-product of refinery processes, and is used partly as a process fuel gas. Certain other isolated energy applications exist, too: for example, as a fuel for rocket motors. Hydrogen is also used indirectly for energy purposes through utilisation of its ability to improve the quality of fossil fuels. The main reasons for the limited use of hydrogen as an energy carrier are to be found in the relatively expensive production process and the lack of a suitable infrastructure for large-scale distribution. As long as the primary energy sources, such as oil or natural gas, are used more or less directly, hydrogen is not competitive. However, these conditions could change if the availability

of conventional energy sources was reduced or their use restricted for environmental or other reasons. Under such conditions, the use of hydrogen as an energy carrier could become an interesting alternative. The earliest that a hydrogen economy, i.e. the large-scale use of hydrogen as an energy carrier within society, could be expected is well into the next century. This report provides a general overview of the technology and development level of the use of hydrogen as an energy carrier. Main headings: -From a gas for balloons to a future energy carrier; a review. -Energy systems using hydrogen. -Some important properties of hydrogen. -Production. -Storage. -Transport. -Use. -Examples of energy systems using hydrogen. -Safety and environmental aspects. -The market. -Research and development.

0801 Production

REFER ALSO TO CITATION(S) 50915

50888 (IZ—8601, pp 66-68) **Production of molecular hydrogen by photosynthetic bacteria with raw starch.** Takahashi, Hajime; Izaki, Kazuo; Ito, Kazutoshi. (Tohoku Univ., Sendai, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Two strains of non-sulfur purple photosynthetic bacteria designated as T-14 and T-20 were grown under illumination and anaerobic conditions in the medium containing 1% suluble starch and 5 mM glutamate. The medium contained 1% each of soluble starch, raw potato starch, raw corn starrch or raw cassava starch. Each culture (5ml) was kept in a gas exchange tube and incubated under argon atmosphere and illumination at 30°C. During the incubation, cultures were stirred continuously, and the rates of hydrogen evolution were measured. During incubation of the strain T-14 for about 30 hours, the organism produced molecular hydrogen when soluble starch or raw starch were used. Out of the 4 starches, raw corn starch produced maximum amount of hydrogen, and the total hydrogen of about 35 ml was produced. In case with the strain T-20, similar result was obtained. When corn starch was used, the hydrogen production was maximum, totaling 37 ml. (2 figs, 1 ref)

50889 (IZ—8601, pp 8-11) **Research on heterogeneous catalysts for photolysis of water and related reactions by visible light.** Onishi, Takaharu; Domen, Kazunari. (Research Lab. of Resources Utilization, Tokyo Inst. of Tech., Tokyo, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Niobium mixed oxides were studied. The results are as follows: (1) It was found that nickel-niobium-potassium mixtures are highly active in the presence of ultraviolet rays. (2) Further investigation was made to identify the most active to photocatalytic reaction among these mixed oxides; $K_4Nb_6O_{17}$ was found to be the most active. (3) It was found that $K_4Nb_6O_{17}$, unlike conventional photocatalysts, is active to generate hydrogen from alcohol or water by itself without need for adding platinum or other catalysts. However, it is inactive under the presence of visible light. (4) On NiO-$K_4Nb_6O_{17}$ which has been subjected to reduction and oxidation, complete photocatalytic decomposition of water was found to occur, thus generating hydrogen and oxygen at the correct chemical ratio. However, this substance was also inactive in the presence of visible light. (3 figs, 1 tab, 6 refs)

0802 Storage

50890 (IZ—8601, pp 73-75) **Hydrogenated silicon as a new material for hydrogen reservoir.** Hiraki, Akio; Iwami, Motohiro. (Osaka Univ., Faculty of Engineering, Suita, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Second derivative spectrum of the infrared absorption of hydrogenated silicon films was studied to get information on bonding states of hydrogen and silicon atoms in hydrogenated silicon films. Micro-crystalline hydrogenated silicon (μC-Si:H) films were produced by sputtering using hydrogen gas. The films formed had 15μm thickness. μC-Si:H of untreated, heat-treated, and HF treated after production were used for the study, and they were found different in the bonded states of Si and H atoms. In the films heat-treated at about 400°C, only the SiH bond was observed. If treated with HF after heat-treatment in air, films with only isolated SiH, SiH_2, and SiH_3 bond structures were obtained. Two adsorption peaks due to SiH on Si(100) and Si(110) surfaces of the micro-crystalline grains near 2100/cm were observed. (4 figs, 1 tab, 1 ref)

0808 Properties

50891 **(NAL-TM—564) Program for high speed calculation of properties of propellant and combustion gas in liquid hydrogen/liquid oxygen rockets.** Wakamatsu, Yoshio; Karita, Takeshi; Kan, Akio. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1987. 41p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770169/JAW.

For the purpose of simulation of the dynamic characteristics of rocket engines, as the code for calculating the properties of propellant and combustion gas exclusively used for hydrogen/oxygen rockets, of which the accuracy and speed are well balanced, TROY was developed. As the equation of state, the Redlich-Kwong (R-K) equation was used, and as occasion demands, a proper regression equation and a theoretical estimation equation were used together. As compared with the existing typical computation code GASP, the relative error somewhat increased, but there was no problem in its practical use, and the computation speed was able to be increased by more than three times. At present in Japan, the development of a large rocket H-II is advanced, and in order to analyze the dynamic characteristics of a liquid hydrogen/liquid oxygen engine LE-7 for its booster, this subroutine is incorporated. For the research on hydrocarbon fuel rockets, the extension of the TROY code coping with methane, propane, kerosene and so on is investigated. (49 figs, 42 tabs, 29 refs)

50892 **Finite chemical kinetic effects in a subsonic turbulent hydrogen flame.** Magre, P.; Dibble, R. (Combustion Research Facility, Sandia National Labs., Livermore, CA (US)). *Combustion and Flame;* **73**: No. 2, 195-206(Aug 1988).

Departures from chemical equilibrium appear in nonpremixed turbulent flames at very high mixing rates, as shown by dimensional analysis based on Damkohler number (characteristic time of mixing over characteristic time of chemical reaction). This paper presents an experimental study that shows departures from chemical equilibrium in a hydrogen-air flame, which is often erroneously considered to have an infinitely fast chemical rate and therefore to be at chemical equilibrium.

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 50483

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 50701, 51829

50893 **(ANL/CNSV-TM—206) The US landfill gas resource: Low-cost biogas from municipal solid waste.** Bogner, J.E. (Argonne National Lab., IL (USA)). Jan 1988. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015870/JAW.

This report, Low-cost biogas from municipal solid waste, covers: numbers and volumes of landfills; gas generation rates; methods; and data and results. 23 refs., 2 figs., 5 tabs. (JF)

50894 **(CRIE—486013) Production of biogas from various biomass materials.** Uehara, Takeshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Mar 1987. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770183/JAW.

A number of papers on the methane production from animal and municipal residues are publicized, but there are few examples of the methane production from vegetable waste and weed. Aiming at the effective utilization of natural energy for agriculture, we have thought of using methane gas, produced from various biomass located widely in the local districts and vegetable wastes from the vegetable processing plants, for the auxiliary heating energy and for making up the CO_2 balance in the agricultural facilities. We have examined how to efficiently produce methane gas for the formerly wasted material as tomato leaves and stems. The result is as follows: 1) Tomato plant, chickweed, and orchardgrass can give equal or twice as much methane gas than the cow manure. 2) Rate of production is increases by grinding or chopping of the materials. 3) Preliminary fermentation increases the initial rate of fermenting but the total production is rather decreased. (18 figs, 5 tabs, 4 refs)

50695 **(DOE/NBM—1052-Vol.4) IEA co-operative project D1 biomass liquefaction test facility project: Volume 4, Analysis and upgrading of biomass liquefaction products.** Elliott, D.C. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88016617/JAW.

This volume describes the product analysis and upgrading efforts undertaken in this cooperative project and the results of those efforts. The analytical program involved analysis of biomass liquefaction products recovered from the Comparative Test portion of the Cooperative Project as well as a number of other similar products which were analyzed for comparison. A few of these products were further tested for the potential of upgrading the raw products to higher-valued products such as transportation fuels or chemicals. As a result of these efforts, the many differences as well as similarities among the various products have been quantified. The products basically fall into one of the two categories---pyrolysis products having high oxygen and dissolved water contents with low viscosities and heating values or high pressure liquefaction products which have lower oxygen and dissolved water contents, but higher viscosities and heating values. More importantly, the differences appear to result from the difference in severity of biomass processing as a result of time at temperature and pressure. The effects of feedstock are substantial only when considering the difference between wood and peat. The peat products contain less oxygen but more sulfur and nitrogen while having significant amounts of actual hydrocarbon. Differences in products produced from various species of soft and hard wood were nearly insignificant compared to the differences between wood and peat products. 25 refs., 7 figs., 16 tabs.

50696 **(DOE/NBM—1062-Vol.1) IEA [International Energy Agency] co-operative project D1 Biomass Liquefaction Test Facility Project: Volume 1, Summary, conclusions and recommendations.** Kjellstroem, B.; Beckman, D.; Elliott, D.C.; Kannel, A.; McKeough, P.; Nissilae, M.; Solantausta, Y.; Oestman, A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88015634/JAW.

Phase 1 of the Biomass Test Facility Project was started 1983-07-01 under annex 1 to the IEA Forestry Energy Implementation Agreement as a joint effort between Canada, Finland, Sweden and USA. The first stage included the following tasks: review of the state-of-the-art of direct liquefaction processes for biomass; comparative tests involving processes currently studied at the laboratory scale in the participating countries; analysis and characterization of liquid products from biomass liquefaction experiments; upgrading tests with products from biomass liquefaction experiments; techno-economic comparison between selected process concepts; and review of work elements for the next stage of the project. The overall objective of the Biomass Liquefaction Test Facility Project is to identify an optimum process for direct liquefaction of biomass. The objective of the first phase of the project has been to provide a basis for design of a pilot scale test facility which implied at least definition of the main characteristics of the most promising process.

50697 **(DOE/NBM—1062-Vol.3) IEA co-operative project D1 Biomass Liquefaction Test Facility project: Volume 3, Results from the Comparative Test Program.** Kjellstroem, B.; Beckman, D.; Elliott, D.C.; Kannel, A.; McKeough, P.; Nissilae, M.; Solantausta, Y.; Oestman, A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016616/JAW.

Conversion and yield data from biomass liquefaction processes can be greatly dependent on the feedstock material. In order to provide a comparison of the many different approaches to liquefaction, two standard feedstocks, consisting of hybrid poplar wood from eastern Ontario and peat from Finland, were sent to nine different laboratories in Canada, Finland, Sweden and the United States. Each laboratory tested the feedstocks under their own process conditions. The processes investigated include vacuum pyrolysis, atmospheric pyrolysis, super-critical extraction and catalytic and non-catalytic high pressure liquefaction. All of these processes employ different methods of feeding, reactor design and product recovery. In addition, high pressure biomass feeding techniques were studied. This paper summarizes the results of the test runs conducted at each facility. Various problems encountered with the test runs at some of the facilities has led to difficulties in interpreting the results of the comparative test program. Although uncertainties exist in the product yields for some of the tests, it can be seen that the product yields do not differ dramatically between the different types of processes covered in this program. However, significant differences in the product properties have been observed. Differences also exist in the yields and product properties between wood and peat tests for similar processes. These differences indicate that wood processes can not be extrapolated directly to apply for peat feedstocks (and vice versa). 2 refs., 22 tabs.

50698 **(DOE/NBM—1062-Vol.5) IEA co-operative project D1: Biomass Liquefaction Test Facility project: Volume 5, Techno-economic assessment of selected biomass liquefaction processes.** McKeough, P.; Nissilae, M.; Solantausta, Y.; Beckman, D.; Oestman, A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 331p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88016679/JAW.

This assessment is part of the Biomass Liquefaction Test Facility (BLTF) project organized by the International Energy Agency (IEA). the overall objective of the project is to identify an optimum process for direct biomass liquefaction. The objective of this task is to provide a basis for the selection of the process concepts to be considered for testing in a possible international test facility. The comparison of the processes is primarily based on estimated production costs of the primary products, taking into account differences in the quality of the products. However, because many of the processes are still at an early stage of development, other factors are considered when comparing the processes. They include: thermal efficiency; technical uncertainty; and limitations on raw materials. Because of limited resources, not all the processes, currently under development, are evaluated in full. Rather, a preliminary selection of six processes is made. Included in these are both high-pressure processes and pyrolysis processes, employing both wood and peat as feedstocks. 25 refs.

50699 **(DOE/OR/21390—9) Great Lakes Regional Biomass Energy Program: Final report, September 1, 1984-August 31, 1985.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Jan 1986. Contract FG05-83OR21390. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88016840/JAW.

This is the final report of the second year of operation of the Great Lakes Regional Biomass Energy Program. During the past year, all seven state energy offices in the region received grants under the State Grant Program. The Wisconsin Division of State Energy and the Michigan Energy Administration provided a total of 67 wood energy economic investment analyses to interested firms and institutions. Of those 67 analyses, the results of 52 indicated positive economic returns resulting from investments in wood combustion equipment. Short rotation forestry was the focus of projects sponsored by the Illinois Department of Energy and Natu-

ral Resources and the Indiana Division of Energy Policy. While the Illinois work focused on coppice production, the Indiana project examined yield-spacing relationships and soil compaction. The Iowa Energy Policy Council devoted a large percent of its grant toward promoting the use of municipal waste as an energy resource. Quantifying the emissions impacts of wood combustion systems in school districts throughout Minnesota was of primary interest to the Minnesota Department of Energy and Economic Development. The Ohio Division of Energy spent most of the year completing its Landsat biomass resource assessment and promoting it to the private sector.

50900 **(DOE/OR/21461—T3) The potential of vegetable oil as an alternate source of liquid fuel for agriculture in the Pacific Northwest - IV: Final report, 1984-1986.** Auld, D.L.; Hall, M.C.; Hawley, K.N.; Korus, R.A.; Madsen, J.P.; Mahler, K.A.; Mora, P.G.; Peterson, C.L.; Roelofsen, M.; Stibal, W.T.; Whitcraft, J.C. (Idaho Univ., Moscow (USA). Dept. of Agricultural Engineering). 1986. Contract AI05-84OR21461. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88016095/JAW.

This research was conducted to develop the technology necessary to produce, process, and utilize vegtable oil as a diesel fuel substitute for agricultural production in the Pacific Northwest. Additional studies were conducted to determine the economic threshold, to derive energy budgets for various crop production regions, and to insure that expeller extracted meals would make acceptable animal feeds. This research was conducted by an integrated team of scientists from the University of Idaho which initiated efforts in this field in December of 1979. Experiments were conducted by agronomists, agricultural engineers, animal nutritionists, chemical engineers, and agricultural economists. This report summarized data accumulated from October 1984 to March 1986 as part of USDA/ ARS Research Agreement No. 58-7B30-2-402. Copies of this report can be obtained from the Director of the Idaho Agricultural Experiment Station, College of Agriculture, University of Idaho, Moscow, ID 83843.

50901 **(DOE/OR/21461—T4) The potential of vegetable oila s an alternate source of liquid fuel for agriculture in the Pacific Northwest - V: Final report, 1986--1987.** Auld, D.L.; Davis, J.B.; Feldman, M.E.; Hall, M.C.; Hawley, K.N.; Korus, R.A.; Magenis, B.R.; Mahler, K.A.; Melville, D.E.; Mosgrove, D.L. (Idaho Univ., Moscow (USA). Dept. of Agricultural Engineering). Jun 1987. Contract AI05-84OR21461. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88016096/JAW.

This research was conducted to develop the technology necessary to produce, process, and utilize vegetable oil as a diesel fuel substitute for agricultural production in the Pacific Northwest. Additional studies were conducted to determine the economic threshold, to derive energy budgets for various crop production regions and to insure that expeller extracted meals would make acceptable animal feeds. This research was conducted by an integrated team of scientists from the University of Idaho which initiated efforts in this field in December of 1979. Experiments were conducted by agronomists, agricultural engineers, animal nutritionists, chemical engineers, and agricultural economists. This report summarizes data accumulated from April 1986 to May 1987 as part of USDA/ARS Research Agreement No. 58-7B30-2-402. Copies for this report can be obtained from the Director of the Idaho Agricultural Experiment Station, College of Agriculture, University of Idaho, Moscow, ID 83843.

50902 **(ESC-WR—88-04) Societal costs and benefits for different approaches of the manure problem.** Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Mar 1988. 18p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This lecture discusses some alternatives to handle the manure problem in the Netherlands. One of the possibilities is yeasting the manure by means of anaerobic bacteria to win biogas or burning dried manure and using the produced energy for heating stables or greenhouses. Transporting manure to places where there is a shortage of manure is another possibility to get rid of the problem. The environmental and energy effects of the manure surplus problem and of the possible solutions are often conflicting. A cost-benefit analysis can be helpful to make the right choices. An estimation is made and figures are given of the societal costs and benefits of environmental and energy effects of different manure processing and transport possibilities in the Netherlands in a representative manure surplus situation. 2 refs., 3 tabs., 6 figs.

50903 **(ESC-WR—88-11) Manure surplus: should it be transported, processed or prevented.** Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Apr 1988. 19p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the Congress on environmental policy in a market economy, Wageningen, Netherlands, 8-11 September 1987.

In the Netherlands there is a large surplus of pig manure. This surplus is concentrated in ecologically sensitive regions from which it must be removed. Truck transport is expensive and unattractive, so that at present the manure is dumped on the land. Alternative solutions for pig manure treatment are described. Energy consumption and environmental aspects are quantified. Techniques of social cost-benefit analysis are explored to help policy makers. 6 figs., 3 refs., 5 tabs.

50904 **(IC—9174) Review of membrane technology for methane recovery from mining operations.** Garcia, F.; Cervik, J. (Bureau of Mines, Pittsburgh, PA (USA)). 1988. 6p. Department of the Interior, Bureau of Mines, Cochrans Mill Rd., PO Box 18070, Pittsburgh, PA 15236.

Recent advances in the commercial separation of gases using membranes have renewed interest in the possibility of applying this technology to the recovery of methane (CH/sub 4/) from mining operations. This Bureau of Mines report briefly reviews the history of the development of membranes for gas separation, the theory of how they work, and their application to the separation of methane from air and associated problems. However, methane-air mixtures are difficult to separate with membranes because of pertinent gas couples, O/sub 2/-N/sub 2/, O/sub 2/-CH/sub 4/, and N/sub 2/-CH/sub 4/, have poor separation characteristics, as indicated by their separation factors of about 3 or less. Even if these separation factors were substantially higher, there is doubt that methane could be recovered economically from the low concentrations in mine ventilation exhaust (2 vol pct or less). The exhaust pressures are not sufficient for adequate separation. The power cost of compressing these mixtures would far exceed the value of the methane recovered. New discoveries could make separation of gob hole methane-air mixtures practical. These mixtures have much higher concentrations of methane (from 30 to 100 volt pct); however, for safety reasons, treatment would be limited to gob gas with 60 vol pct CH/ sub 4/ or more.

50905 **(LBH—8312) A comparative assessment of forest biomass conversion to energy forms. Phase 1. Vol. 5. Data book of unit processes for primary conversion by thermal, chemical, and biological methods.** (Levelton (B.H.) and Associates Ltd., Vancouver, British Columbia (Canada); Simons Resource Consultants Ltd., Vancouver, British Columbia (Canada)). Dec 1983. 386p. (CE—01354). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This volume presents a discussion of the commercial and near-commercial unit processes of gasification, pyrolysis, direct liquefaction, hydrolysis, and fermentation. For all unit processes, data were assembled for operating performance, equipment cost, and installation cost. A review of experience obtained by equipment users is given if such information was available. For gasification, processes include updraft, downdraft, stirred-bed, and fluid-bed types. The most proven applications for gasification technology are the generation of fuel gas with minimal cleanup for direct combustion in a boiler, dryer, engine for power generation, or the like. Pyrolysis processes are another proven technology, and the ones included in this report can be classified into kiln, fixed-bed, and fluid-bed systems. Direct liquefaction processes are emerging technology and are only briefly discussed. The hydrolysis unit process includes pretreatment, acid hydrolysis, and enzymatic hydrolysis. Dilute acid hydrolysis processes are near-commercial technology and are dis-

cussed individually. Enzymatic hydrolysis is emerging technology and is discussed briefly. Included in the fermentation section are processes for hexose and pentose sugars; processes for converting hexose sugars to ethanol or mixtures are considered. Operating performance of commercial processes are discussed under generic headings. Much of the discussion of fermentation processes is based on traditional feedstocks, since there is a lack of commercial installations for sugars derived from wood hydrolysis. 109 refs., 81 figs., 43 tabs.

50906 **(NP—8770350) Enhancement of the effectivity of anaerobic sewage sludge stabilization by a thermal pretreatment of the sludge.** Pinnekamp, J. (Technische Hochschule Aachen (Germany, F.R.). Gesellschaft zuer Foerderung der Siedlungswasserwirtschaft). 1987. 335p. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88770350/JAW.

The object of this study was to examine whether or not a two-stage sewage sludge stabilization process will benefit from a thermal pretreatment of the sludge exceeding 100/sup 0/C in the first stage by bringing about an improved energy balance in the anaerobic treatment of the sludge in the second stage concurrently with enhanced sludge stabilization. Studies were implemented in extended bench scale. The test facility comprised an autoclave for the first stage and four continuous digesters. Various test series involved different sludge types and test objectives. Maximum increase rates of specific gas yield depend from the type and origin of sludges and from pretreatment temperature, with a pretreatment temperature ranging between 135/sup 0/ and 180/sup 0/C resulting in the highest increase rate. The organic moiety of solids proved to be the decisive parameter for the increase of gas yield to be expected.

50907 **(ORNL/TM—10882) Energy conservation benefits incidental to microemulsion fuel use.** Compere, A.L.; Griffith, W.L. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015425/JAW.

Microemulsion fuels have small droplets, usually 2 to 100 nanometers diameter, of a non-continuous phase mixture dispersed in base fuel. The dispersed phase consists of a mixture of a surfactant, which can be a fatty acid soap, and water, often with an alcohol added to increase stability. Microemulsions provide a unique opportunity to modify engine performance by changing fuel composition and combustion, including emissions. Although microemulsion fuel physical characteristics are very similar to those of the neat base fuel, they can contain up to 25% biomass-derived materials. Opportunities for conservation using microemulsion fuels include petroleum sparing, distillate fuel extension during a petroleum supply interruption, and decreased energy cost of emissions control. For example, if microemulsion fuels technology can be developed sufficiently to permit application, it could be used to provide 3 to 8 billion lb of distillate fuel extenders from routinely stored agricultural materials during a petroleum supply interruption. Similar technology has promise for providing diesel fuels which have lowered NO/sub x/ and particulate emissions, effectively using a group of biomass materials to extend distillate fuel by direct energy replacement and by decreasing the energy expended in emissions controls. A successful technology might save 0.1 to 0.3 Quads in projected emissions control energy while substituting 0.5 to 0.6 Quads of biomass-derived materials for petroleum at the turn of the century. Recommendations for key research required to determine the most effective uses of this technology are explored in detail. 14 refs., 6 tabs.

50908 **(PIRSEM—2041) Hydrocarbon biosynthesis by Botriococcus braunii alga.** (Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM)). 1986. 12p. (In French). NTIS (US Sales Only), PC A03/MF A01; GPO Dep. Order Number DE88754041/JAW.

The hydrocarbon biosynthesis mechanisms of Botriococcus braunii alga are investigated: the hydrocarbons produced are: n-alcadienes and uneven trienes from C25 to C31, and botryococcenes of general formula CnH2n-10 (n=30 to 37). The struture and the stereochemistry of these hydrocarbons are determined and their formation mechanisms (elongation-decarboxylation mechanism type) are precised; the nature of their key-intermediates is identified (precursor fatty acids, activated derivatives).

50909 **(PNL—6114) Bench-scale studies on fluid-bed pyrolysis of wood.** Mudge, L.K.; Brown, M.D.; Wilcox, W.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015834/JAW.

The primary objective of this study was to determine the effects of different contact gases and experimental conditions on product yields from fluid-bed wood pyrolysis. The yield of condensible hydrocarbons was of particular interest. The contact gases employed included carbon dioxide (CO_2), methane (CH_4), and hydrogen (H_2). Reaction temperatures ranged from 650{degree}C to 800{degree}C, and gas contact time was between 1 and 2 s. Tests with CO_2 contact gas used a secondary vessel of catalyst for cracking of condensibles generated in the primary gasifier. Results of earlier studies at PNL showed the effectiveness of various catalysts for destruction of condensible hydrocarbons. Analyses of results on the effects of contact gas, reaction temperature, gas contact time, and wood feed rate are presented in this report, along with a description of experimental equipment and methods. Data were obtained from single tests at each set of experimental conditions. Conditions were not repeated to determine the amount of experimental error. Material balance closures were generally quite good for the experimental tests, within 10%. 9 refs., 15 figs., 16 tabs.

50910 **(PNL—6600) Fundamentals, development and scaleup of the air=oxygen stratified downdraft gasifier.** Reed, T.B.; Levie, B.; Graboski, M.S. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 287p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88015836/JAW.

In 1979 the US Department of Energy, Office of Alcohol Fuels, asked the Solar Energy Research Institute to develop a process for manufacturing methanol from biomass. This can be achieved by gasification of the biomass to a "synthesis gas" (syn-gas) (composed of primarily hydrogen and carbon monoxide) followed by catalytic conversion of the gas to methanol. The catalytic conversion of syn-gas is a well developed commercial process. There are a number of gasifiers for wood, but most of them make either a producer gas, high on nitrogen or a pyrolysis gas high in hydrocarbons. None were developed to make syn-gas. Thus the principal technical problem was to develop a gasifier to make synthesis gas from biomass. Work was performed at SERI from 1980--1985 which resulted in the development of a prototype 1 ton/day oxygen-biomass gasifier. In 1985 a program was undertaken for Congress by the US Department of Energy (DOE) to build a commercial scale (50--200 tons/day) medium energy gasifier, based on DOE or other research. A new company, Syn-Gas Inc. (SGI), research. A contract was awarded to SGI to modify the air gasifier for oxygen operation for this project. This modification allowed extended tests of the gasifier with oxygen to determine the possibility of scaling up the SERI-SGI gasifier to 50--200 tons/day.

50911 **(PNL-SA—15439) Thermal gasification of biomass: An update on DOE's research program.** Schiefelbein, G.F. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 7p. (CONF-880702—20). NTIS, PC A02. Order Number DE88015463/JAW.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Biomass represents an important energy resource at present and offers great potential for increased energy impact in the future. The Office of Technology Assessment and the Energy Research Advisory Board have estimated that, with proper resource management and the development of efficient conversion processes, biomass is capable of supplying ten to twenty percent of the nation's energy needs by the year 2000. This future potential is expected to be met in part by gasification of biomass to produce gaseous fuels. These gaseous fuels can be widely substituted for natural gas and oil in existing industrial energy use patterns. In addition, they can serve as feedstocks for the production of liquid transportation fuels such as methanol, ethanol and gasoline. Wood and crop residues

constitute about 95% of the biomass feedstocks available for conversion to energy. Thermal gasification processes are capable of converting over 95% of the organic material in these feedstocks with little sensitivity to variations in the feed material. In this paper biomass gasification research sponsored by the US Department of Energy's Biomass Thermochemical Conversion Program is discussed. The main thrust of this research is directed toward the production of medium-energy content gases containing 12-21 MJ/NM^3. This research effort encompasses both directly heated and indirectly heated gasification reactor concepts. Research on fixed-bed and entrained gasification reactors operating at ambient and elevated pressures will be discussed. Information on a unique gasification process for high moisture feedstocks and research on catalytic gas cleanup methods will also be presented. 7 refs., 9 figs., 2 tabs.

50912 (RAPAD—8501, pp 1-13) **Manufacture of synfuels from syngas.** Sep 1985. Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and Development on Synfuels.

This report explains reseaches on the manufacturing technology of hydrocarbon fuel and the manufacturing technology of oxygen-contained fuel oils. The former means the manufacturing technology of liquid fuel from syngas and is categorized into the Fischer-Tropsch (F-T) process to produce gasoline and middle distillates and the process to produce mainly high octane gasoline. Concerning the F-T process, the development of catalysts ($Ru/ThO_2/A1_2O_3$, etc.) which maximize yields of products from syngas and the method to utilize them to the maximum extent are explained. As for the process to produce high octane gasoline, the development of catalysts (H-2SM-%, etc.) for synthesizing synfuels directly from syngas and their utilization method are explained. The latter mentioned in top above is the development of the technology to produce efficiently by catalysts higher alcohol which is used for the mixture of alcohol and gasoline, referred to as gasohol, and the development of catalysts (NiTi, NiAl, Ni/TiO_2, CuNiMIa, etc.) and their utilization tests are explained. (10 figs, 6 tabs)

50913 (RAPAD—8502, pp 7-25) **Production technology of new fuel oil from synthetic gases(1). Production technology of hydrocarbon oil.** 1985. (In Japanese). NTIS (US Sales Only), PC A02/MF A01 - Available from Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and development of new fuel oil.

The objectives of this research are the development of catalysts which will produce, in high yield, liquid hydrocarbons such as gasoline fraction, middle distillate, etc., and the development of a process for enabling such catalysts to fulfill their functions. Search for catalysts, and studies on life tests, regeneration system and production in larger scale for promising catalysts were carried out. A bench scale suspension bed reactor was operated to evaluate the performance of catalysts and study the process of suspension behavior of vapor-liquid-solid. This time, performance of $Ru/Th0_2/Al_20_3$ catalyst which has Ru and $Th0_2$ supported by alumina was studied. A new catalyst of Ru/oxide was found out which possesses the reaction characteristic similar to $Ru/Th0_2$. As to the MTG process, study on synthesis conditions of new solid acid, improvement of existing solid acids by chemical modification method, experiments on processes, etc. were carried out. As regards the STG process, higher yield of C5+ gasoline resulted with the slurry bed as compared with the fixed bed. (18 figs, 4 tabs)

50914 (RAPAD—8502) **Research and development of new fuel oil.** (Research Association for Petroleum Alternatives Development, Tokyo (Japan)). 1985. Vp. (In Japanese). Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

Selected papers have been processed separately for inclusion in the Energy Data Base.

50915 (RFW—TE87-7) **Alternative fuels, production costs.** (Webb (R.F.) Corp. Ltd., Ottawa, Ontario (Canada)). Feb 1983. 319p. (CE—01800). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The principal objectives of this investigation were to estimate Canadian production costs of alternative fuels for 44 selected processes, to provide a data base for the selected processes, to define the flow scheme, technology and plant configuration for each process consistent with its data base, to review constraints affecting the economics of alternative fuels, to review data base results against known transport fuel prices and market trends and provide preliminary evaluations of the economics of the fuels and processes considered. The alternative fuel categories are presented, including alcohol, synthetic hydrocarbon liquids, propane, liquefied natural gas, hydrogen, ammonia, octane boosters, and broad cut fuel. Each category covers the following topics: review of manufacturing processes, feedstock considerations in Canada, plant gate production costs, discussion of processes and plant gate costs, properties and performance as a transport fuel, and user costs. In the case of alcohol and propane fuels, their production capacity, price history and projections are also discussed. An overview and comparison of base data are presented for all the processes considered and appendices include detailed process descriptions, process economics worksheets, and assumptions used in establishing the data base. The investigation demonstrated that sufficient information is now available to permit the identification of alternatives to petroleum products, even though a precise ranking of all the types investigated is not possible. 78 refs., 53 figs., 117 tabs.

50916 (SERI/CP—231-3355) **Thermochemical Conversion Program annual meeting: Proceedings.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1988. Contract AC02-83CH10093. 281p. (CONF-8806176—). NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88001187/JAW.

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The US Department of Energy (DOE) is actively developing renewable energy resources through research and development programs sponsored by the Office of Renewable Energy Technologies. These Proceedings describe biomass conversion projects sponsored by the Biomass Thermochemical Program within the Biofuels and Municipal Waste Technology Division of the Office of Renewable Energy Technologies. Pacific Northwest Laboratory has been designated the Technical Field Management Office for the Biomass Thermochemical Conversion Program with responsibility for overall field management of the program.

50917 (SNV—3160) **Composition of power fuels for vehicles. Report no 1.** Pettersson, M. (National Swedish Environmental Protection Board, Solna). Jun 1986. 105p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88754428/JAW.

The report presents: -results of a limited fuel investigation comprising premium and regular gasoline, diesel fuel and light diesel fuel from four different suppliers; -a catalogue of fuel additives patents pending in Sweden; -a summary of present legislation about fuels and car engine exhaust gases; -a discussion of health and environmental effects of fuels considering the present legislation.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 50907, 51575, 51576, 51577, 51578

50918 (CPP—88) **Bioconversion of waste wood to liquid fuel: the state-of-the-art.** Wayman, M. (Canadian Pulp and Paper Association, Montreal, Quebec). 1988. 3p. (CE—01817; CONF-8801110—). Canadian Pulp and Paper Association of Canada, Sun Life Building, 23rd. Floor, 1155 Metcalfe St., Montreal, P.Q., Canada H3B 2X9; $3.00 CAN.

From 74. annual meeting of the technical section, Canadian Pulp and Paper Association; Montreal, Canada (25 Jan 1988).

The cost of energy purchased by pulp and paper mills has increased dramatically in the last 10 years. Bioconversion to liquid fuels such as ethanol is a means of upgrading waste wood which promises security of supply as well as economic benefits. The technology of ethanol production from wood has become quite simple, as described in this paper. This involves hydrolysis of the wood waste, filtration of lignin and fermentation of the wood sugars fol-

lowed by distillation and dehydration. A plant to supply enough ethanol to replace all presently purchased liquid fuels at a 150,000 tonnes per annum integrated pulp and paper mill in Canada would cost $7.5 million to build. An internal supply of ethanol would also be of considerable importance to a solvent pulping operation. 9 refs., 1 fig., 2 tabs.

50919 **(DOE/CE/50181—H1) Fuel alcohol formulations.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems; Svensk Drivmedelsteknik AB, Stockholm). Sep 1988. Contract GI01-87CE50181. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016753/JAW.

This work was conducted through the collaborative efforts of the International Energy Agency (IEA) Working Group on Alcohols and Alcohol Blends as Motor Fuel, consisting of representatives from Canada, Italy, Japan, Sweden and the United States. Under Annex 2 of the IEA Agreement on this subject, "Technology Information Exchange on Motor Alcohols," the Swedish Motor Fuel Technology Company (SMAB) seeks, collects, collates, and sometimes assesses data and information on new work in the field. This information supplements the three-volume report of early 1987 on the state-of-the-art of production and utilization technology titled "Alcohols and Alcohol Blends as Motor Fuel." Since there is considerable interest in and a future need for fuel alcohol specifications, one of the efforts under Annex 2 was to review the fuel formulations used in field activities and the results of previous workshops on the subject. This document presents the results of that plus discussion on key points that would be considered in determining specifications. The contribution of Dr. Claes Pilo of SMAB was key to achieving this. The Executive Committee of this IEA working group recognizes that development and adoption of fuel specifications are functions of individual countries wherein there are existing organizations and procedures to do this. This document may be helpful to those organizations, and is intended as a service to aiding the technical community as it moves in that direction. 37 refs., 5 figs., 3 tabs.

50920 (IZ—8601, pp 31-34) **Development of a fermentor producing ethanol using immobilized yeast. Study of rate process.** Furusaki, Shintaro; Kikuchi, Tatsuji; Seki, Minoru. (The Univ. of Tokyo, Faculty of Engineering, Tokyo, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Theoretical and experimental studies were carried out for immobilized yeast cells entrapped in solid gel to learn the changes in the reaction rate. Especially, the effect of diffusiion resistance in single substance gel was studied in detail. Immobilized resting and growing yeasts were used for the study. Diffusivity coefficients D depends upon cell density C, and can be expressed in the equation $D/E=K_2(1-K_1C)^2$, where E is the diffusivity in water; K_1 and K_2 are constants. Reaction rates of immobilized resting yeast are given in a figure which well coindide with experimented rates. The good coincidence of theory and actual measurement indicates that the activity after immobilization of yeast does not differ much as compared with liberation. Immobilized growing yeast was observed to maintain its activity in liberation even after the immobilization in the same manner as the resting yeast. (5 figs, 3 tabs, 3 refs)

50921 **(PB—88-232764/XAB) Biological and biochemical methane reactions. Annual report, March 1987-February 1988.** Dalton, H.; Willse, A.R.G.; Pienkos, P.T.; Stirling, D.I. (Celgene Corp., Warren, NJ (USA)). May 1988. 47p. NTIS, PC A03/MF A01.

See also PB—87-211967.

This project is aimed at determining those features of the enzyme methane monooxygenase that contribute to its catalytic conversion of methane to methanol. Biological and biochemical efforts identified the essential nature of the bi-metal center at the active site of the enzyme, solubilized its more active copper-dependent form, and found and screened many new methanotrophs that function in widely different chemical and physical environments.

50922 (RAPAD—8501, pp 51-71) **Fuel alcohol production from cellulosic biomass. Biomass coversion and utilization.** Sep 1985. Research Association for Petraleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and Development on Synfuels.

Pretreatment methods for various celulosic materials have been studied, and those for wood are now under research and development. The result of the electron beam irradiation - chlorine treatment - alkali treatment conducted on actual waste wood is given in the form of a table. To increase cellulase productivity, improvement of strains and culture conditions are being studied. In 1984 basic conditions for cell fusion tests were studied. Trichoderma reesei was improved and hyper-cellulase-producing strains were obtained. Methods to efficiently prepare concentrated sugar liquids were studied and large scale saccharification of cellulose was carried out. Research was conducted on the production of ethanol from chemically treated bagasse by SSF process. Treatment of distillation waste lioquor by using membranes was also studied. Integrated bench-plant for ethanol production from cellulose was designed and portions of the plant was completed. In the field of butanol production process, screening programs to isolate new thermophilic anaerobe from nature have been conducted. As a basic test in fermentaion by immobilized cells, the composition of culture medium and culture conditions were studied. A strain capable of producing 18.2g/l of solvent was obtained by screening and NTG mutagenesis. (15 figs, 7 tabs)

50923 **(RAPAD—8501) Research and Development on Synfuels.** (Research Association for Petroleum Alternatives Development, Tokyo (Japan)). Sep 1985. Vp. Research Association for Petraleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

Selected papers have been indexed separately for the Energy Data Base.

50924 (RAPAD—8502, pp 26-34) **Production technology of new fuel oil from synthetic gases. Production technology of oxygen containing fuel.** 1985. (In Japanese). Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and development of new fuel oil.

The objective of this research is to develop an efficient production technology of low grade alcohol mixture from synthetic gas by catalytic reaction. In 1984, studies on composition ratio of Cu-Ni series catalysts, addition of fourth component, and studies on alkali species were performed, and the composition of the components was made to optimum. Request was made for the preparation of Cu-Co series catalyst in large scale which is to be used at the pilot plant for the operation study as the basic catalyst. To get a guideline for catalyst improvement, performance mechanism of Cu-Ni series catalyst was investigated. The primary evaluation of the catalyst was made by a catalyst activity testor and a microreactor. Then the secondary evaluation and the evaluation of the reaction stability were carried out. Analytic devices for products and data processing equipment were installed, the construction of all the facilities was completed, and the system was run with the selected catalyst as the basic catalyst. The result of the reaction and composition of the products are introduced. (5 figs, 4 tabs)

50925 (RAPAD—8502, pp 190-135) **Biomass utilization technologies. Cellulose decomposition fermentation technologies.** 1985. (In Japanese). Research Association for Petroleum Alternatives Development, 1-4-2, Uchikanda, Chiyoda-ku, Tokyo.

In Research and development of new fuel oil.

This article is a part of the FY 1985 open annual report concerning research and development of new fuel oils prepared by Research Union of Technology Development of New Fuel Oils and describes on the following five fields:1)Physical pretreatment fermentation process- Research on the production processes of fuel ethanol from agricultural and forestry wastes. Study of pretreatment conditions and improvement of cellulase production yeasts, etc.. 2) Integrated bench plant (physical pretreatment fermentation)- Development of production system of fuel ethanol using cellulose biomass as feedstock. Verification by bench plant. 3) Chemical pretreatment fermentation process- Development of energy saving

chemical pretreatment technologies and basing thereupon, development of highly efficient ethanol production process. 4) Search for new kinds of yeast- Development of cheap and powerful cellulase which is the point for the successful ethanol production from cellulose biomass. 5) Butanol fermentation process- Development of technologies for efficient fermentation production of butanol. (26 figs, 11 tabs)

50926 **Ethanol from biomass by enzymatic hydrolysis.** Wright, J.D. (Solar Energy Research Institute, Golden, CO (US)). *Chemical Engineering Progress;* **84**: No. 8, 62-74(Aug 1988).

Enzymes are biological catalysts that generally are designed to do one job well, but to do one job only. Therefore, the enzymes that catalyze the hydrolysis of cellulose to sugar do not break down the sugars. Thus, enzymatic processes are capable of yields approaching 100%. Enzymatic hydrolysis processes have been under development for only 10 years. Although improvements have been made in enzymatic technology, more are both possible and necessary. The important research issues include understanding the processes necessary to render the crystalline cellulose easily digestible, understanding and improving the basic mechanisms in the hydrolysis step, and developing better and less expensive enzymes. The hemicellulose fraction (25%) is primarily composed of xylan, which is simple to convert to the simple sugar xylose, but the xylose is difficult to ferment to ethanol. There were no practical systems for xylose fermentation 10 years ago. Today, methods have been identified using new yeasts, fungi, bacteria, and processes combining enzymes and yeasts. Although none of the fermentations is yet ready for commercial use, considerable progress has been made. The following sections describe current research efforts in each of the major areas (cellulose hydrolysis, xylose fermentation, and lignin conversion), with an emphasis on enzymatic hydrolysis using fungal enzymes.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 50915

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 50899, 50926, 50959, 50975, 51552

50927 **(BFR-R—104-1987) Conversion of group heating plants - Wood chip firing versus heat pumps.** Nordling, J. (AaF Energikonsult AB, Stockholm (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 62p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754390/JAW.

This report is an economic comparison of conventional oil firing and wood chip firing in group heating plants. Three alternatives of wood chip firing have been compared: wood chip firing alone, and wood chip firing in combination with two different types of heat pumps. Flue gas condensation provided the heat source for the heat pumps in both cases. The two types of heat pumps were absorption heat pumps and a steam-turbine-driven compressor heat pump. Plant sizes for the various designs were 2 MW and 800 kW. They were installed in group heating plants with respective output power ratings of 6 MW and 2.5MW. A fairly basic system design has been employed for the steam-turbine-driven heat pump alternative, operating at a low ratio of mechanical shaft power output to heat output. The economic calculation have been carried out using the present value method, all three alternatives in both size groups exhibit relatively good profitability. The most profitable is a straight wood chip firing system. This is followed, in order of economic merit for the assumptions applying here, by the absorption heat pump in combination with a wood chip boiler. (authors).

50928 **(CPP—88) Development and performance of a direct fired pulverized biomass combustion process.** Lincoln, J.F.L.; Litchney, T.C. (Canadian Pulp and Paper Association, Montreal, Quebec). 1988. 9p. (CE—01815; CONF-8801110—). Canadian Pulp and Paper Association of Canada, Sun Life Building, 23rd. Floor, 1155 Metcalfe St., Montreal, P.Q., Canada H3B 2X9; $3.00 CAN.

From 74. annual meeting of the technical section, Canadian Pulp and Paper Association; Montreal, Canada (25 Jan 1988).

Weyerhaeuser has committed significant resources to the development of biomass energy technologies which will directly substitute for oil and natural gas. Major in-house oil and gas uses include supplementary firing in wood waste boilers and operation of lime sludge kilns in kraft pulp mills. Process options for both wood gasification and pulverized fuel firing technologies have been examined. The pulverized fuel firing development program investigated areas of combustion fundamentals, burner design and development, fuel drying, fuel metering, pulverization and overall process design. Short term full-scale burner tests demonstrated the feasibility of pulverized biomass firing into a water-walled furnace without fossil fuel support forflame stabilization. A full-scale burner test facility was built to gain long-term with pulverized biomass burners, and to serve as a test bed for component development. The parallel fundamentals and implementation efforts developed both process understanding and the practical experience necessary to ensure reliable performance in an operating environment. Based on the two efforts, a direct-fired process design (no storage of pulverized fuel) has been developed which requires no fossil fuel for flame stabilization. Design and performance of the first commercial application of the technolgy at Weyerhaeuser's pulp mill in Cosmopolis, Washington is described. Other potential applications of the technology are discussed. 3 refs., 7 figs.

50929 **(DOE/OR—21390-T24) Biomass resources: Generating jobs and energy.** (Council of Great Lakes Governors, Inc., Madison, WI (USA); Employment Research Associates, Lansing, MI (USA)). Nov 1985. Contract FG05-83OR21390. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015078/JAW.

The objective of this project is to analyze the economic impacts resulting from the increased use of the region's biomass resources to reduce the region's expenditures for imported energy. In order to accomplish this aim, three questions were addressed. First, which biomass energy forms currently make significant contributions to the region's energy balance? Second, what are the economic impacts of current biomass use? Third, what positive impacts will result from the continued growth and development of biomass energy through 1995? Of the numerous biomass resources which could potentially be exploited to produce energy, three are making significant contributions: wood, corn (for fuel alcohol), and municipal waste.

50930 **(DOE/OR/21390—T13) Handbook for conversion to wood energy systems: Guide for conversion of commercial, industrial and public facilities to wood as their primary energy source.** (Council of Great LDtract FG05-83OR21390. 1 GPO Dep. Order Number DE88015067/JAW.

It is the intent of this workbook to show potential users of wood residues, densified wood, and pelletized solid wastes, the steps that must be taken to construct the burning systems for their facilities. The workbook will show the types of equipment available, how it should be used, the pitfalls awaiting the unwary and methods of financing the systems.

50931 **(DOE/OR/21390—T14) Wood energy system design.** (Council of Great Lakes Governors, Inc., Madison, WI (USA); Georgia Inst. of Tech., Atlanta (USA). Research Inst.; Progressive Engineering Consultants of Grand Rapids, MI (USA)). [1988]. Contract FG05-83OR21390. 229p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88015069/JAW.

This handbook, Wood Energy System Design, was prepared with the support of the Council of Great Lakes Governors and the US Department of Energy. It contains: wood fuel properties; procurement; receiving, handling, and storage; combustion; gasification; emission control; electric power generation and cogeneration; and case studies. (JF)

50932 **(PB—88-219027/XAB) Timber harvest and transport.** Richardson, B.Y. (Forest Service, San Dimas, CA (USA). Equipment Development Center). 1984. 9p. NTIS, PC A02/MF A01.

This report describes equipment being developed and tested to harvest timber, recover associated residues, and transport the wood products to the primary processing facility. The machines being tested include concentrators, bundlers, rakes, grapples, and chippers.

50933 **(SRC—C258) A comparative assessment of forest biomass conversions to energy forms. Phase 1. Proven and near-proven technology. Vol. 4. Data book of unit process for primary conversion by direct combustion.** (Simons Resource Consultants Ltd., Vancouver, British Columbia (Canada)). Dec 1983. 301p. (CE—01859). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This volume deals with processes which convert forest biomass into heat by direct combustion. The volume is divided into two parts. In steam generation, wood is converted into thermal energy by combustion and the thermal energy generates steam. The two conversions take place in a single piece of equipment, so it is common to consider steam generation as a single-step process. In hot gas generation, the primary energy form is hot gas resulting from combustion of biomass. Typically, this gas is used for some secondary function, such as drying lumber or heating thaw ponds. It may also be used for generating steam in a separate boiler (waste heat boiler), which distinguishes the process from direct steam generation. Where it is difficult to distinguish between the two process divisions, the process is arbitrarily assigned to that division which seems to suit it best. This volume presents technical and operating characteristics of equipment used in the above two processes. Specific types of quipment described are: wood-fired boilers, chemical recovery boilers, ash handling systems, suspension burners, single and multiple chamber combustors, and fluidized bed combustors. 29 refs., 109 figs., 8 tabs.

50934 **(SRC—C258) A comparative assessment of forest biomass conversion to energy forms. Vol. 9. Systems for utilization of biomass fuels.** (Simons Resource Consultants Ltd., Vancouver, British Columbia (Canada)). Dec 1983. 227p. (CE—01858). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This volume describes seven examples of wood energy systems that are of widespread industrial interest. Numerous assumptions were made in the development of these examples, but in all cases, every effort was made to select a system configuration and size that is applicable to Canadian industry. The systems chosen for analysis are for kiln drying of lumber, production of wood fuel pellets, furnish drying, cogeneration, power generation using a gasifier, firing a lime kiln with wood wastes, and ethanol production by acid hydrolysis of wood. The system examples are presented to illustrate the functionality and versatility of the unit-process approach and the general method that should be used in applying data on specific kinds of equipment. The discussion for each example elaborates on the equipment and dollar value of the produced energy. Each discussion states the scope of the analysis design assumptions and the cost items which have been included and excluded. Sufficient detail is given in examples to readily reproduce the calculated costs and facilitate investigation of alternate system configurations and equipment choices. The discussion for each example presents the cases for the system configuration, equipment selection, capital costs, operating costs, material and energy balances, and economic analysis. 27 refs., 29 figs., 60 tabs.

50935 **(SRC—C258) A comprehensive assessment of forest biomass conversion to energy forms. Phase 1. Proven and near proven technology. Vol. 3. Data book of unit process for fuel preparation and handling.** (Simons Resource Consultants Ltd., Vancouver, British Columbia (Canada)). Dec 1983. 442p. (CE—01860). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This volume describes, evaluates, summarizes, and compares commercially proven or near proven unit processes required for fuel preparation and handling of forest biomass. Each chapter contains a table describing the best application for each piece of equipment. The data book is organized into sections in the sequence that unit processes are most likely to be used in a system, starting at the plant gate, and are: storage and reclamation, handling, comminution, classification, mechanical dewatering, thermal drying, and densification. Data on the process rated of equipment are based on utilizing western Canadian softwoods. The choice of equipment must be primarily concerned with its correct application and adequate sizing. The source and type of forest biomass handled will determine the system design, and the conversion process. Other matters of related importance are: the location of a fuel preparation and handling system, which may be restricted due to various pollution emissions. The construction, sizing, properties and management of an uncovered fuel pile, and the total installed cost. 9 refs., 128 figs., 88 tabs.

50936 **(STU—86-4199) Combustion of wood fuel - theoretical models. Final report step 1.** Gustafsson, B.; Rundstroem, T. (Energiteknisk Utveckling AB, Trosa (Sweden)). (Swedish National Board for Technical Development, Stockholm). 12 Aug 1987. 22p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754454/JAW.

There is a need for a useful theoretical model of the combustion of large wood particles on a grate. This report is the result of a review of existing models, aiming at a plan for developing a better one. The pyrolytic process is probably best by the VTT model. Simplified radiation models and models of the combustion of the pyrolysis products and the remaining carbon can be fetched from existing incomplete models.

0906 Gaseous Waste Fuels

REFER ALSO TO CITATION(S) 50926

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 51070

50937 **(CRIE-U—87012) Verification of numerical model for sea bottom configuration through comparison with field observation data.** Maruyama, Koki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1987. 40p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754535/JAW.

The prediction model for changes in sea bottom configurations has been practically applied step by step. This study deals with the application of the model for the sea field near the existing power station and the verification of the model by comparing the measurements. This model consists of three sub-models: (1) wave calculation, (2) nearshore current calculation, and (3) calculation of sand transport and configuration change. For each sub-model, the parameters were calibrated by comparing the measurements. For the sand transport formula, a new method was introduced, by which the sand transport was evaluated by using the simultaneous records by a current meter and a sand face meter. Then, by using the whole model in which the sub-models are cooperated, beach changes in the sea field near the power station (1.2 km x 1.2 km) for a period of 20 days were simulated. The results were compared with the measurements. It has been demonstrated that this model has a sufficient applicability for changes in the sea field caused by

erosion and accretion, though the model has some problems further to be improved. (21 figs, 10 tabs, 12 refs)

1301 Resources And Availability

50938 **(SV-UL—1987-15) Ice problems in hydro power plants.** Billfalk, L. (Swedish State Power Board, Aelvkarleby). 26 Aug 1987. 14p. (CONF-8706335—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754467/JAW.

From Workshop on hydropower in cold climate; Trondheim, Norway (30 Jun 1987).

A survey directed to Swedish power companies has shown that the areas of engineering ice mechanics that are of most concern to hydro power operation can be divided into the following three groups: 1. Ice against structures, i.e. forces, manoeuvrability of gates and other mechanical equipment. 2. Problems caused by frazil, i.e. intake clogging, turbine interference and anchor ice formation. 3. Head losses caused by ice covers and ice jams. A number of ice problems encountered at Swedish hydro power plants are presented and methods to combat and reduce such problems are discussed. A major problem is the formation of frazil. Clogging of intakes and other problems caused by adfreeze of frazil will cease once the actual river reach has become ice covered. Conditions for ice cover formation on rivers is therefore also discussed, and the need for more research regarding basic mechanisms in the process of ice cover formation is pointed out. The ultimate goal, from an engineering point of view, would thus be to develop mathematical models whereby ice cover formation on rivers can be accurately predicted.

1306 Environmental Aspects

50939 **(CONF-8805180—1) Assessing cumulative impacts to elk and mule deer in the Salmon River Basin, Idaho.** O'Neil, T.A.; Witmer, G.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011951/JAW.

From International conference on ungulate behavior and management; College Station, TX, USA (23 May 1988).

In this paper, we illustrate the method, using the potential for cumulative impacts to elk and mule deer from multiple hydroelectric development in the Salmon River Basin of Idaho. We attempted to incorporate knowledge of elk and mule deer habitat needs into a paradigm to assess cumulative impacts and aid in the regulatory decision making process. Undoubtedly, other methods could be developed based on different needs or constraints, but we offer this technique as a means to further refine cumulative impact assessment. Our approach is divided into three phases: analysis, evaluation, and documentation. 36 refs., 2 figs., 3 tabs.

50940 **(TVA/ONRED/AWR—88/5) Fishery status assessment of Watts Bar Reservoir with management recommendations.** Alexander, C.M. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Sep 1987. 67p. NTIS, PC A04/MF A01. Order Number DE88016099/JAW.

Watts Bar Reservior was impounded in 1942 and has been inventoried 16 of the following 44 years. The previous inventory was 1980. Fish biomass has increased over the years, most noticeably in prey and commercial species. Sport fish biomass has been the most stable overall. However, creel data indicate some important sport species numbers have had extreme fluctuations. 21 refs., 20 figs., 9 tabs.

50941 **(TVA/ONRED/AWR—88/18) Bacteriological water quality in the downstream end of Fort Loudon Reservoir during the 1986 drought.** Fehring, J.P. (Tennessee Valley Authority, Chattanooga (USA). Div. of Air and Water Resources). Mar 1988. 31p. NTIS, PC A03/MF A01. Order Number DE88016108/JAW.

During the summer of 1986, two bacteriological surveys were conducted on Fort Loudoun Reservior. One was part of the Tennessee Valley-wide study in 1986 to assess impacts of the drought on the water quality of the reservior system. The stations sampled were not part of the scope of the western Knox County study, which is the primary purpose of this report, but are included in this report to better describe water quality in Fort Loudoun Reservior. The main scope of this study was an appraisal of water quality in a small portion of the Fort Loudoun drainage area in western Knox County. The study area focused on three areas of interest, Keller Bend, Sinking Creek at Concord, and Turkey Creek. 6 refs., 4 figs., 5 tabs.

50942 **(TVA/ONRED/AWR—88/25) Middle Fork Holston River watershed biological assessment, summers of 1986 and 1987.** Saylor, C.F.; Hill, D.M.; Ahlstedt, S.A.; Brown, A.M. (Tennessee Valley Authority, Chattanooga (USA). Div. of Air and Water Resources). May 1988. 62p. NTIS, PC A04/MF A01. Order Number DE88016107/JAW.

Fish and macroinvertebrates were collected to obtain a qualitative and quantitative determination relating the impacts of land use activities on aquatic fauna and water quality in watersheds of the Middle Fork Holston River. Samples were compared to historical data, used for calculating an Index of Biological Integrity (IBI), and examined for diversity and abundance of macroinvertebrates. Most IBI's determined for subwatersheds of the Middle Fork Holston River (MFHR) supported land use inventories and soil loss estimates previously completed by TVA in 1985. These inventories targeted streams likely to be impacted by siltation, agricultural runoff, and other nonpoint pollution sources. Findings indicated that siltation and enrichment had increased in the mainstream of MFHR since 1969. Several sites exhibited characteristics implying additional forms of pollution which were impacting the fauna. Benthic macroinvertebrate samples were helpful in documenting degradation but did not always support IBI's and land use inventory and soil loss estimates. Macroinvertebrate fauna are typically more resilient and recover faster than fish fauna, offering a partial explanation for this phenomenon. 6 refs., 3 figs., 12 tabs.

14 SOLAR ENERGY

50943 **(TNO-TPD—327.224) The development of a short term test procedure for solar boiler systems.** Keizer-Boogh, E.M.; Havinga, J. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Jan 1987. 57p. (In Dutch). Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

This report describes the development of a test method for new solar boilers. The test is executed under a solar simulator, lasts several days, and is restricted to operation control and characterization of the solar boiler. A simple characterization is possible with the help of an input/output curve. On the basis of the test results one can estimate the annual yield. Before the test procedure was developed some international test procedures were studied and compared. The basic principals of the test are discussed. The influence of different factors on the test result is examined with the help of the TPD computer model for a solar boiler. This resulted in the definition of the test cycle with accompanying circumstances. A start for making a format to report the test results is made. A solar boiler has been subordinated to the test cycle several times. This resulted in a few adaptations of the test. Finally the usefulness of this test method is discussed and some attention is given to the state of the matter. 5 app., 13 figs., 8 refs., 2 tabs.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 51506

50944 **(ARC/IE—8603) Solar and wind energy monitoring project, 1977-1985.** (Alberta Research Council, Edmonton (Canada). Industrial and Engineering Research Div.). Mar 1986. 308p. (CE—01812). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As part of a program to carry out a detailed assessment of Alberta's solar and wind energy resources, this report presents data

collected from monitoring sites, each measuring 11 meteorological parameters. These sites were at Fort McMurray, Edson, Ellerslie (Edmonton), Rocky Mountain House, Coronation, Pincher Creek and Lethbridge. The 11 parameters were wind speed, wind direction, air temperature, global solar radiation, diffuse radiation, ground reflected radiation, net radiation and the solar radiation incident on vertical surfaces in the north, east, south and west directions. The sensors and data logging equipment were designed to provided 24 hour per day unattended service and continuous integration of the data produced. The data were decoded on a microcomputer and then processed into summaries. A selection of the measured parameters is plotted and analyzed in this report. Two examples of applying these solar and wind data are presented using the energy requirement to pump water. One limiting factor which reduced the desirable length of the data acquisition period was the sophisticated but less-than-reliable monitoring system. The comparisons of these data to other information available would seem to confirm their validity. However, the duration of data collection was too short to permit development of statistical confidence limits for prediction of the available energy resource at other locations. The result of this multi-year program indicate that continuation of long-term acquisition of radiation and wind data on a province-wide network, while desirable, is not essential. However, site-specific studies focused on particular applications are warranted. 17 refs., 129 figs., 75 tabs.

50945 **(BFR-R—112-1987) Solar radiation in Sweden. Time and spatial distribution.** Josefsson, W. (Sveriges Meteorologiska och Hydrologiska Institut, Norrkoeping (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 275p. (In Swedish). NTIS (US Sales Only), PC A12. Order Number DE88754392/JAW.

The objective of this work has been to provide better knowledge of available Swedish solar radiation data and of the characteristics of solar radiation, and in particular of its variations in time and space. The report describes the terminology used. Various concepts of time are considered and equations for determining the position of the sun are given. The section on spatial variation considers variability on various scales: large-scale, meso-scale, small-scale and local variations. The feasibility of extrapolating and interpolating solar radiation data for a site for which measurements are not available is considered. Variations in global radiation with respect to various time scales are treated in detail. Measurement periods shorter than ten years do not provide a sufficiently detailed picture of the solar radiation climate of a site in Swedish latitudes. Parallel variations in global radiation, temperature, wind and diffuse radiation are considered. The most common methods of calculating solar radiation are presented. A comprehensive collection of tables and maps in an appendix includes details of monthly values of global radiation and hours of sunshine, together with reviews of the radiation climate in Sweden and other details.

50946 **(EC—EN56-64/1-1984) Solar radiation data analyses for Canada, 1967-1976. Vol. 1. The Atlantic provinces.** McKay, D.C.; Morris, R.J. (Environment Canada, Ottawa, Ontario). 1985. 267p. (In English and French). (CE—01851). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulation models have been implemented to estimate solar radiation and its components on horizontal and various tilted surfaces at sites in Canada where hourly meteorological observations are taken and archived. The models have been executed for 24 sites in the Canadian Atlantic provinces for 1967 to 1976, summary statistics have been calculated, and the results are presented in the maps and tables of this publication. With due allowance for the accuracy limitations of the modelling techniques, this publication provides substantial solar radiation climatological information of interest to all disciplines that utilize solar radiation data, particularly those dealing with solar energy systems. 8 refs., 55 figs., 25 tabs.

50947 **(EC—EN56-64/2-1984) Solar radiation data analyses for Canada, 1967-1976. Vol. 2. Quebec.** McKay, D.C.; Morris, R.J. (Environment Canada, Ottawa, Ontario). 1985. 219p. (In English and French). (CE—01852). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulation models have been implemented to estimate solar radiation and its components on horizontal and various tilted surfaces at sites in Canada where hourly meteorological observations are taken and archived. The models have been executed for 18 sites in Quebec for 1967 to 1976, summary statistics have been calculated, and the results are presented in the maps and tables of this publication. With due allowance for the accuracy limitations of the modelling techniques, this publication provides substantial solar radiation climatological information of interest to all disciplines that utilize solar radiation data, particularly those dealing with solar energy systems. 8 refs., 55 figs., 19 tabs.

50948 **(EC—EN56-64/3-1984) Solar radiation data analyses for Canada, 1967-1976. Vol. 3. Ontario.** McKay, D.C.; Morris, R.J. (Environment Canada, Ottawa, Ontario). 1985. 259p. (In English and French). (CE—01853). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulation models have been implemented to estimate solar radiation and its components on horizontal and various tilted surfaces at sites in Canada where hourly meteorological observations are taken and archived. The models have been executed for 23 sites in Ontario for 1967 to 1976, summary statistics have been calculated, and the results are presented in the maps and tables of this publication. With due allowance for the accuracy limitations of the modelling techniques, this publication provides substantial solar radiation climatological information of interest to all disciplines that utilize solar radiation data, particularly those dealing with solar energy systems. 8 refs., 55 figs., 24 tabs.

50949 **(EC—EN56-64/4-1984) Solar radiation data analyses for Canada, 1967-1976. Vol. 4. The prairie provinces.** McKay, D.C.; Morris, R.J. (Environment Canada, Ottawa, Ontario). 1985. 323p. (In English and French). (CE—01854). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulation models have been implemented to estimate solar radiation and its components on horizontal and various tilted surfaces at sites in Canada where hourly meteorological observations are taken and archived. The models have been executed for 31 sites in the Canadian prairie provinces for 1967 to 1976, summary statistics have been calculated, and the results are presented in the maps and tables of this publication. With due allowance for the accuracy limitations of the modelling techniques, this publication provides substantial solar radiation climatological information of interest to all disciplines that utilize solar radiation data, particularly those dealing with solar energy systems. 8 refs., 55 figs., 32 tabs.

50950 **(EC—EN56-64/5-1984) Solar radiation data analyses for Canada, 1967-1976. Vol. 5. British Columbia.** McKay, D.C.; Morris, R.J. (Environment Canada, Ottawa, Ontario). 1985. 243p. (In English and French). (CE—01855). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulation models have been implemented to estimate solar radiation and its components on horizontal and various tilted surfaces at sites in Canada where hourly meteorological observations are taken and archived. The models have been executed for 21 sites in British Columbia for 1967 to 1976, summary statistics have been calculated, and the results are presented in the maps and tables of this publication. With due allowance for the accuracy limitations of the modelling techniques, this publication provides substantial solar radiation climatological information of interest to all disciplines that utilize solar radiation data, particularly those dealing with solar energy systems. 8 refs., 55 figs., 22 tabs.

50951 **(EC—EN56-64/6-1984) Solar radiation data analyses for Canada, 1967-1976. Vol. 6. The Yukon and Northwest Territories.** McKay, D.C.; Morris, R.J. (Environment Canada, Ottawa, Ontario). 1985. 159p. (In English and French). (CE—01856). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Computer simulation models have been implemented to estimate solar radiation and its components on horizontal and various tilted surfaces at sites in Canada where hourly meteorological observations are taken and archived. The models have been executed for 1 site in the Yukon and 11 sites in the Northwest Territories for 1967 to 1976, summary statistics have been calculated, and the results are presented in the maps and tables of this publication. With due allowance for the accuracy limitations of the modelling techniques, this publication provides substantial solar radiation climatological information of interest to all disciplines that utilize solar radiation data, particularly those dealing with solar energy systems. 8 refs., 55 figs., 13 tabs.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 50893, 50894, 50895, 50896, 50896, 50897, 50898, 50898, 50899, 50900, 50901, 50903, 50905, 50905, 50906, 50907, 50909, 50910, 50911, 50916, 50918, 50920, 50925, 50926, 50928, 50931, 50934, 50935, 51070, 51385, 51552, 52127, 52154, 52265, 52330, 52331

50952 **(CFS/NF—NOR-X-257) Biomass equations for six major tree species of the Northwest Territories.** Singh, T. (Canadian Forestry Service, Edmonton, Alberta. Northern Forest Research Centre). 1984. 24p. (CE—01809). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Biomass data obtained from 336 trees representing six major species of the Northwest Territories were used to derive regression equations for estimating ovendry biomass for stem and nonstem components. The predictor variables were the diameter at breast height outside bark and the total height of the tree. Prediction equations based on three models were derived for merchantable stem, nonmerchantable stem, live large branches, and live small branches including foliage. The best estimates were provided by a multiple regression model using five predictor variables. Equations are included for predicting total ovendry biomass of living tree above ground with and without foliage. Also presented are 95% confidence bands for the ovendry biomass weight prediction and pie diagrams for the stem and nonstem biomass dry weights. 6 refs., 5 figs., 6 tabs.

50953 **(CFS/SF—LAU-X-52E) Prospects for the use of forest biomass in Quebec.** Lussier, L.-J.; Maranda, J. (Canadian Forestry Service, Sainte Foy, Quebec). Oct 1983. 73p. (CE—01828). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The main objectives of this study were to assess the production potential of forest biomass in Quebec; determine the current use of this potential; estimate surplus biomass by source and by product category; forecast the use of surplus biomass over the next decade, quantify the practical availability during the same period; examine possible conflicts between current and new uses of biomass; suggest, if necessary, means of reducing these conflicts; and make general recommendations with regard to the use of surplus forest biomass over the next ten years. Since Quebec forests cover a vast area, the territory was divided into 26 separate study units. The total above-ground wood biomass available annually, in Quebec's forests, is 35 million m/sup 3/ or 15 million oven-dry metric tonnes under extensive management. Logging residues represent 10% of this quantity, merchantable full trees 60%, and unmerchantible trees 30%. The energy equivalent of this biomass represents annually 3.6 billion litres of oil. 7 figs., 20 tabs.

50954 **(CPP—88) Biomass to energy conversion: process and economic simulation on a personal computer.** Edwards, W.; Wasik, L. (Canadian Pulp and Paper Association, Montreal, Quebec). 1988. 7p. (CE—01818; CONF-8801110—). Canadian Pulp and Paper Association of Canada, Sun Life Building, 23rd. Floor, 1155 Metcalfe St., Montreal, P.Q., Canada H3B 2X9; $3.00 CAN.

From 74. annual meeting of the technical section, Canadian Pulp and Paper Association; Montreal, Canada (25 Jan 1988).

Wood residue fuels are used extensively in the forest products industry to generate steam and electricity. Considerable potential exists for expanded use of forest biomass for fuel in these, as well as less traditional industry sectors. A user-friendly interactive computer simulation model (BIOSIM) has been developed for a personal computer to make it possible to quickly estimate capital and operating costs for many bionenergy systems. The user may select and assemble system components from a library of simulation modules to anlayze and estimate the cost of specific systems of interest. BIOSIM calculates material balance, power requirements, energy output, capital cost, operating costs and other information, presenting it in a tabular form for easy use in an economic analysis. 3 refs., 2 figs.

50955 **(CRIE-T—86053) Storage battery operation technique of photovoltaic system.** Kobayashi, Hirotake; Takigawa, Kiyoshi; Takeda, Yukihiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752074/JAW.

A large scale capacity of several megawatt-hours is needed for the battery system annexed to a large scale solar power generation system of magawatt class. In this large scale battery system a lot of small scale unit batteries are connected so that, after repeated charge and discharge cycles, an imbalance of residual capacities of the individual batteries takes place due to the dispersion of the charge and discharge characteristics thereof and also to the influence from the impedance of the DC lines interconnecting the unit batteries. As a result it causes the system storage capacity to diminish. Therefore, an operating characteristics simulation program for the battery system has been developed that calculates the temporal variation of the residual capacity of the unit batteries from such items as the charge and discharge I-V characteristics of the battery, the resistance values of the DC interconnection lines, the variation of solar irradiance and so on; the program has been verified through the experiments in the actual field test; and the basic conditions of an appropriate charge and discharge control system for the batteries to possibly suppress the imbalance of the residual capacity have been clarified. (35 figs, 5 refs)

50956 **(DOE/ER/13739—T1) [Molecular studies of functional aspects of higher plant mitochrondria]: Annual progress report covering the period August 1, 1987--March 15, 1988.** Siedow, J.N. (Duke Univ., Durham, NC (USA). Dept. of Botany). 1988. Contract FG05-87ER13739. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014723/JAW.

A 13 kDa protein, encoded by a gene specifically associated with the mitochondrial genome of Zea maize containing the cms-T trait, has been correlated susceptibility of maize to infection by the fungal pathogen, Biopolaris maydis, race T. Additional work had indicated that mitochondria from cms-T plants were specifically sensitive to BmT toxin produced by this fungus, such that addition of BmT toxin to cms-T maize mitochondria induced a massive leakage of low molecular weight. The gene encoding the 13 kDa polypeptide (urf13-T) was cloned into E. coli using the pATH-3 expresion vector under control of the trp promoter.

50957 **(DOE/OR/00033—T407) The influence of density on stand development, biomass partitioning and nutrient allocation in {und Albizia} {und lebbek} (L.) Benth. plantations in Puerto Rico.** Parrotta, J.A. (Oak Ridge Associated Universities, Inc., TN (USA); Yale Univ., New Haven, CT (USA)). Dec 1987. Contract AC05-76OR00033. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88015640/JAW.

The influence of plant density on growth, yield, and rates of nutrient accretion in above ground and belowground biomass were evaluated for {und Albizia} {und lebbek} (L.) Benth. plantations in Puerto Rico. The density treatments included in the study were 2500, 10000, and 40,000 trees per hectare. During the first two years of stand development tree growth was measured in each of nine experimental plots on a quarterly basis. Periodic destructive sampling of randomly selected trees provided data for the assessment of biomass and nutrient content of individual tissue components and for total standing biomass and its aboveground and belowground distribution. 108 refs., 32 figs., 30 tabs.

50958 **(DOE/OR/21390—T17) Short-rotation intensive culture of woody crops for energy: Principles and practices for the Great Lakes Region.** (Meridian Corp., Falls Church, VA (USA)). [1988]. Contract FG05-83OR21390. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88015079/JAW.

This document is intended to serve as an introduction and general guide to short-rotation intensive culture (SRIC) of woody crops for energy, especially as applicable to the Great Lakes Region. Individual chapters discuss and explain all major aspects of plantation establishment and management, including: species and site selection; available planting stock; site preparation practices and planting options; and plantation management and cultural requirements and options. Additional chapters examine the environmental considerations associated with SRIC; currently available wood harvesting and handling options, along with R&D directions and prototypical equipment development; and the economics of SRIC systems operation. Though oriented principally toward conditions in the Great Lakes Region, coverage of the fundamental concepts and considerations associated with SRIC is general enough to make this guidebook useful in much of the US. 49 refs., 34 figs., 12 tabs.

50959 **(DOE/OR/21390—T23) Herbaceous energy crop production systems for marginal land in the Great Lakes region: Final report.** Majerus, K.A. (Illinois Univ., Urbana (USA). Dept. of Forestry). 1986. Contract FG05-83OR21390. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015074/JAW.

Alternative land uses are needed for sites considered marginal for conventional row-crop agriculture. Improper land use can decrease site quality and soil productivity. The economic impacts of excess US agricultural crops point toward conversion of marginal lands to systems other than food production. Herbaceous energy crop production offers an alternative to row-cropping on marginal land. The following report provides information on herbaceous crop production on marginal land in the Great Lakes region (IL, IN, IA, MI, MN, OH, WI). To date, research on production of herbaceous crops for energy purposes has been limited. Information on relevant herbaceous species exists largely in relation to hay, silage, and forage production. 32 refs., 6 figs., 4 tabs.

50960 **(DU/IRES—ENFORP40) Forest biomass and nutrient studies in central Nova Scotia. Part 5. Summary Report: effect of potential nutrient removals with intensively harvested biomass on continued site productivity.** Freedman, B.; Duinker, P.N. (Dalhousie Univ., Halifax, Nova Scotia (Canada). Inst. for Resource and Environmental Studies). Aug 1985. 39p. (CE—01864). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report summarizes major findings of a research program involving measurements of standing crops and fluxes of biomass and nutrients in a variety of forest stands in central Nova Scotia. Stands were selected to represent major forest types in the region as well as a range of inherent site fertility. An objective of this research program was to predict potential biomass and nutrient removals by whole-tree clearcut harvests of these stands, relative to conventional clearcuts. These nutrient removals were also compared with the magnitudes of other significant nutrient compartments and fluxes in the stands, including: the sizes of the forest floor and soil nutrient pools, in both total and plant-available forms; quantity of nutrients in ground vegetation; nutrients incoming via precipitation; stemflow and throughfall fluxes; and litterfall fluxes. Summaries and interpretations are presented of all data that were gathered. It was seen that moderate increase in potential biomass yield via the whole-tree harvest is obtained at the expense of much larger increases in removals of major nutrients. It seems unlikely that one or several whole-tree harvests of these natural stands, if done on rotations of > ca 50 years, will result in important depletions of site nutrient capital. However, calcium removals as a percentage of total site capital appear to be large. 49 refs., 10 tabs.

50961 **(INIS-mf—11309, pp 156) /sup 13/C NMR applied to the study of lignin structure.** Robert, D.; Bardet, M.; Lundquist, K. (Centre d'Etudes Nucleaires de Grenoble, Departement de Recherche Fondamentale, Laboratoires de Chimie, Grenoble, (France); Chalmers Univ. of Tech., Goeteborg (Sweden)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

50962 **(ISI-B—13-86) Concept for energy supply to the sewage treatment plant of Kronau, a plant of the 'Abwasserzweckverband Kraichbachniederung'.** Kunz, P.; Lohr, R.; Mueller, A. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Karlsruhe (Germany, F.R.). Inst. fuer Systemtechnik und Innovationsforschung). 12 May 1986. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754580/JAW.

The study investigates the economic efficiency of a modular cogeneration plant for power generation from digester gas produced by the Kronau sewage plant. On the basis of the energy bill made up and the scope for investment given, possible types of plant are selected and examined.

50963 (IZ—8601, pp 76-78) **Fundamental study on weather-proof amorphous solar cells.** Matsumura, Hideki; Hirose, Masataka. (Hiroshima Univ., Faculty of Engineering, Hiroshima, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

The objective of this study is to develop a new deposition technology for new amorphous semiconductors suitable as materials for weather-proof solar cells. Amorphous silicon (a-Si) and amorphous silicon-carbide (a-SiC) were produced by glow discharge decomposition of the mixture of intermediate species SiF_2 and H_2, and the mixture of SiF_2, CF_3 and H_2 gas. Their charactersitics, stability under light illumination, etc. were investigated. It was found that a-Si produced by this method is more stable for strong light soak than the conventional a-Si produced by glow discharge of the conventional SiH_4, has high heat-resistive property, and its optical band gap can be controlled from 1.65 eV to 2.2 eV without apparent degradation of photoconductive properties. It became clear that the amorphous semiconductors made by this method are promising candidate as maerials for low-cost and weather-proof solar cells. (5 figs, 4 refs)

50964 (IZ—8601, pp 60-65) **Development of membrane reactor to biological system.** Shoda, Makoto; Kubota, Hiroshi; Sasaki, Yoshizumi. (Research Lab. of Resources Utilization Tokyo Inst., of Tech., Tokyo, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Fondation.

Bioreactors with oxygen permeable membranes were developed and its characteristics were studied. 2 types of reactors, VM and VH, with volume of 500 ml each were fabricated. VM had a membrane of 38.7 cm^2 at the bottom, and was shaken at the rate of 170 rpm. HM is a horizontalized version of VM with membranes on both sides. Varying the amount of liquid and rotation rate of the reactor, oxygen transfer volume coefficients were measured for VM. Oxygen permiation rate evidently increased with the reactor equipped with membrane as compared with oxygen permeation at the top of a reactor without membrane. In the case of HM type as well, high oxygen transfer effect was observed with increased

volume of operation. To confirm the oxygen transfer effect of the reactor, bacteria were grown in the reactor and the growth pattern was investigated. The oxygen concentration and consumption of glucose clearly reflected the effect of the reactor. (4 figs, 2 tabs, 2 refs)

50965 (IZ—8601, pp 57-59) **Development of novel CdS thin film solar cells with high efficiences using field-effect.** Saraya, Junji; Matsumura, Nobuo. (Kyoto Inst. of Tech., Kyoto, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-28 Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Novel MIS (Metal-Insulator-Semiconductor) structure was fabricated combining Al_2O_3 insulation film and Cds film as the first step of developing novel solar cells, and the interface state of Al_2O_3-Cds was analyzed for C-V (capacitance-voltage) characteristics. Under a light illumination to this MIS structure, internal photovoltage was observed as expected. Leak currents through MIS structures were negligibly small at a bias of -10V because of the improved insulation resistance and dielectric strength of Al_2O_3 film. The analysis of C-V charactersitics revealed that the interface state density was as low as less than $1X10^{11}$ 1/cm²eV and the semiconductor surface band could be bent strongly upward by the field effect. Photovoltaic effect was found to be one of the cause for a capacitance increase under a light illumination. (6 figs, 2 tabs, 2 refs)

50966 (IZ—8601, pp 27-30) **Development of alloy semiconductor crystals for new-type and high-efficiency solar cell system.** Fujita, Shigeo; Takeda, Yoshikazu. (Kyoto Univ., Faculty of Engineering, Kyoto, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Fondation.

Gaseous transport technique using iodine was applied to alloy semiconductors to learn the growth conditions. Prior to the growth experiments on ternary alloys, GaAs and InAs binary compounds the characteristics of which were well known had been grown to get information on the growth conditions. Single crystals of these binary compounds were successfully grown at the temperature of 850°C and temperature gradient of 1°C/cm, introducing 5mg iodine/cm³ of the ampule volume. In the above growth conditions, growth of bulk crystals GaInAs and GaAsP was tried. As of now, no single crystal was obtained. GaAsP alloy was grown at the conditions similar to those for the binary compounds both for $GaAs_{0.6}P_{0.4}$ and $GaAs_{0.4}P_{0.6}$. The characteristics istics of the crystal quality of GaASP alloy were evaluated by x-ray diffraction, Auger Electron Spectroscopy and light transmission. (3 figs, 4 refs)

50967 (IZ—8601, pp 4-7) **Study on a new preparation method of amorphous silica.** Abe, Yoshisaki; Ogino, Keizo; Misono, Takahisa; Oura, Nobuyuki. (Science Univ. of Tokyo, Faculty of Science and Tech., Tokyo, Japan). 20 Aug 1986. (In Japanese). NTIS (US Sales Only), PC A02/MF A01 - Available from Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

An attempt was made to synthesize amorphous silica through the condensation of silicic acid and its organic derivatives to investigate a new method for synthesizing amorphous oxides. The results are as follows: (1) A silica lump was produced through the condensation of silicic acid in an organic solvent; (2) A silica fiber and a silica fine powder were produced from polymers of silicate ester; (3) Polysiloxanes with a marked spinnability were obtained through the silylation of silicic acid. This spinnability is not found in silicone. Also, such a good spinnability is not observed when the silicon sensitive radical (silanol radical) is replaced with an alcoxy or acetoxy radical. Therefore, the spinnability seems to be due to the link between silanol radicals and between silanol radicals and hydrogen in the solvent. The results of the study are being utilized to synthesize metalloxy high polymers and amorphous oxides the precursor of which are metalloxy high polymers. (7 figs, 4 tabs, 10 refs)

50968 **(LU/FFG—PIX29) The role of nitrogen fixation in intensive forestry in Canada. Part 2.** Fortin, J.A.; Chatarpaul, L.; Carlisle, A. (Laval Univ., Sainte-Foy, Quebec (Canada). Faculte de Foresterie et Geodesie; Carlisle Consultants, Deep River, Ontario (Canada); Institut Forestier National de Petawawa, Chalk River, Ontario (Canada)). 1983. 113p. (CE—01656). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A program of work was funded to provide the scientific and technological basis for future use of nitrogen-fixing plants to maintain soil fertility and increase yield in intensive forestry systems. This work also examined some of the of propagation, planting, and pests and diseases encountered during establishment. Field experiments consisting of Alnus and other tree species on a variety of sites and at different spacings were established for future use. Preliminary results indicated that alders greatly increased the yield of hybrid poplar. Alder also contributed litter to the soil and improved leaf size and nitrogen status of associated Albies balsmea. Nitrofication occurred in the acid alder humus. Methods were developed to: isolate and culture Frankia symbionts, test their effectiveness, store the symbionts in a gene bank, and inoculate them on a large operational scale. Sporulating and non-sporulating strains of Frankia were differentiated and the ability to sporulate, as well as the spectrum of sugars, has been suggested as a basis for Frankia taxonomy. Operational use of inoculated alders indicates that a good supply of phosphorus is vital to the success of the alder. Populus balsamifera leaf and bud leachates were found to contain phenolic acids and had allelopathic effects on alder. It was found that both Alnus crispa and Alnus ruqosa formed ectomycorrhiza with epidermal Hartig nets in conjunction with several fungal partners. The form of these ectomycorrhizae differed from those on the Pinaceae with cortical nets. Some of the ectomycorrhizal fungi on older form symbioses with other trees and shrubs. The possibility that the network of hyphae in forest soils act as a pathway for fixed nitrogen was tested. Appendices contain biomass and nutrient regression equations. 60 refs., 101 tabs.

50969 **(NEI-SE—13) Influence of ammonium nitrate fertilization on physiology and ecology of cyanobacteria (blue-green algae), microfungi and lichens.** Haellbom, L. (National Swedish Environmental Protection Board, Solna). 14 Oct 1985. 22p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754410/JAW.

The following aspects of the problem were investigated: 1.Influence of various nitrogen sources on growth and morphology of some microfungi. 2.Influence of ammonium nitrate on the presence of mycorrhizae in root ends of pine-trees. 3.Influence of ammonium nitrate fertilization on soil bound nitrogen fixation in a pine-tree clump. 4.Physiological examinations for a better understanding of the lethal effect of ammonium nitrate on nitrogen fixation of lichens. (with 24 refs.)

50970 **(PPRI—8308) Hog fuel drying using vapour recompression. Phase 2.** Azarniouch, M.K. (Pulp and Paper Research Inst. of Canada, Pointe Claire, Quebec). Aug 1983. 87p. (CE—01824). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A continuous hog fuel drying pilot plant based on the principle of mixing hog fuel with a hot oil as the heat transfer medium and recirculating the hog fuel-oil suspension through a heat exchanger was designed, built and successfully operated. Live steam from a boiler was used as heat source, thus simulating vapour recompression, i.e. when the heat for drying is supplied by recycled low pressure steam. The capacity of the pilot plant is approximately 5 kg/h of hog fuel (dry basis) and the effective heat exchanger area is about 0.4 m/sub 2/. Hog fuel drying with crude tall oil, a wood-based by-product of the kraft pulping process, as the heat transfer medium resulted in overall heat transfer coefficients from about 100 to 400 W/m/sup 2//sup 0/K. The product moisture and oil contents were in the ranges from less than 10 to 26% (wet, oil free basis) and from 17 to 26% (dry basis), respectively. Even higher

heat transfer coefficients and lower product moisture and oil contents were obtained with a commercial petroleum based heat transfer oil. 5 refs., 5 figs., 3 tabs.

50971 **(SAND—87-8022) Final report on the power production phase of the 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant.** Radosevich, L.G. (Sandia National Labs., Livermore, CA (USA)). Mar 1988. Contract AC04-76DR00789. 166p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88015367/JAW.

This report describes the evaluations of the power production testing of Solar One, the 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant near Barstow, California. The Pilot Plant, a cooperative project of the US Department of Energy and utility firms led by the Southern California Edison Company, began a three year period of power production operation in August 1984. During this period, plant performance indicators, such as capacity factor, system efficiency, and availability, were studied to assess the operational capability of the Pilot Plant to reliably supply electrical power. Also studied was the long-term performance of such key plant components as the heliostats and the receiver. During the three years of power production, the Pilot Plant showed an improvement in performance. Considerable increases in capacity factor, system efficiency, and availability were achieved. Heliostat operation was reliable, and only small amounts of mirror corrosion were observed. Receiver tube leaks did occur, however, and were the main cause of the plant's unscheduled outages. The Pilot Plant provided valuable lessons which will aid in the design of future solar central receiver plants. 53 refs., 46 figs., 4 tabs.

50972 **(SERI/STR—211-3344) Research on high-efficiency, single-junction, monolithic, thin-film amorphous silicon solar cells: Final technical report, February 1987.** Aspen, F.E.; Grimmer, D.P.; Jacobson, R.L.; Jeffrey, F.R.; Tran, N.T. (Solar Energy Research Inst., Golden, CO (USA); Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). Jun 1988. Contract AC02-83CH10093. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001177/JAW.

This report describes research on high-efficiency, single-junction, monolithic, thin-film amorphous silicon solar cells in five task areas: a-Si materials; nonsemiconductor materials; a-Si solar cells; monolithic, intraconnected cells and submodules; and multichamber deposition systems. Among many results, researchers found that good film properties can be obtained at a deposition rate of 8 A/s using a 33% silane-in-hydrogen mixture; low-level phosphorous-doped a-Si:H films exhibit no detectable degradation with light soaking; and the p-window structure appears to be more stable than the n-window structure. The performance of such top contacts as SnO_2/ITO, Ag/ITO, and SnO_2/Ag/SnO_2 was compared with that of single-layer ITO. A new web treatment system for a-Si solar cells was developed that reduces contamination from the web. Submodules with active areas of more than 70 cm^2 were produced with active-area efficiencies of more than 4%. The fabrication technique involved laser scribing, screen printing, vapor deposition, and laser heat treatments. A multichamber deposition system was also designed and constructed that deposited a-Si p-i-n and n-i-p layers on a flexible polyimide web in a continuous, roll-to-roll deposition process. 11 refs., 55 figs., 4 tabs.

50973 **(SLU-IEM—23) Vegetation and flora of short-rotation willow stands from a conservation viewpoint.** Gustafsson, L. (Swedish Univ. of Agricultural Sciences, Uppsala. Dept. of Ecology and Environmental Research). 1986. 144p. NTIS (US Sales Only), PC A07. Order Number DE88754414/JAW.

The energy forests were studied using random 0.5 x 0.5 m quadrats in which cover for field- and bottom-layer species was recorded in a percentage scale. The data were analysed using various multivariate methods. The vegetation and flora of twelve coppices in southern Sweden were investigated. Also the succession during the establishment phase on a meadow on the west coast and on a peat bog in the east-central part of the country was studied. Moreover, the impact on fen vegetation downstream of an energy forest on a peat bog was investigated. The flora and vegetation of energy forests is dominated by common ruderal species like Cirsium arvense, Galeopsis tetrahit and Urtica dioica. Uncommon species from woodland and fen habitats are only occasionally found. The field layer of energy forests shows a clear seasonality with maximal cover in July. The species number and the composition of vegetation vary greatly between the coppices and is largely determined by the management system. Intense cultivation including fertilization and the use of herbicides depletes the flora. Long rotation times decrease both species diversity and the field-layer cover. Uncommon species are mostly found in old coppices, which also often have a rich spring flora. A change in flora and vegetation occurs when an energy forest is established. The change is great and the time needed for stabilization of the energy forest flora is long when the original flora is dissimilar to the coppice flora. Willow coppices can increase habitat diversity in regions dominated by coniferous forests or in large-scale agricultural areas. Structural heterogeneity of a stand promotes diversity of the flora. Such heterogeneity can be created if a stand is composed of a variety of willow clones, if it is harvested at intervals, contains gaps, open ditches and is surrounded by edge zones of various types.

50974 **(SLU-ISS—19) Published and unpublished biomass studies in the Nordic countries. An annotated bibliography up to 1982.** Albrektson, A.; Frivold, H.; Holstener-Joergensen, H.; Maelkoenen, E. (eds.). (Union Internationale d'Electrothermie (Sweden)). 20 Feb 1986. 326p. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88754415/JAW.

The intention of this report is to expose Scandinavian forest research to the international audience. The report is an annotated bibliography up to 1982 and contains 278 references from Denmark (50), Finland (64), Norway (23) and Sweden (141). The bibliography concerns tree biomass described as weight, fractions, structure, density, litterfall etc. Traditional forest research, considering stem volume, are also perspicuously exposed. (authors).

50975 **(SRC—C258) A comparative assessment of forest biomass conversion to energy forms. Vol. 2. The unit process approach to energy systems, technical background data, and bases for process evaluations.** (Simons Resource Consultants Ltd., Vancouver, British Columbia (Canada)). Dec 1983. 109p. (CE—01857). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This volume contains reference material on the approach that has been used in developing the data and on the characteristics of forest biomass fuels that are often needed for anlysis of an energy system. Technical data for the characteristics of biomass fuels are compiled from published literature and general experience, and arranged for easy reference. To assist in assessing the feasibility of a biomass energy system at a site of interest, a thorough discussion with numerical data is given for both the type and yield of wood residues, and the energy requirements at typical forest products plants in Canada. With these data, a preliminary estimate for the quantity of fuel available as a by-product and of the requisite amount of thermal and electrical energy for operation of the production process may be readily made. The volume concludes with a discussion of the concepts and bases used to evaluate commercial and emerging technology. Assumptions used to develop equipment costs, operating costs, and the economic analysis of systems are summarized. 53 refs., 10 figs., 31 tabs.

50976 **(SRC—C258) A comparative assessment of forest biomass conversion to energy forms. Phase 1. Proven and near-proven technology. Vol. 6. Data book of unit processes for modification and upgrading of energy forms.** (Simons Resource Consultants Ltd., Vancouver, British Columbia (Canada)). Dec 1983. 198p. (CE—01861). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This volume covers unit processes for modification and upgrading of the various energy forms produced by conversion processes. Specifically, the unit processes for particulate and condensible material removal, fuel and synthesis gas upgrading, and alcohol separation are considered as they apply to the processing of an

energy form. For example, particulate and condensible material removal processes are required for cleaning of raw fuel gas before delivery to an engine, or before upgrading to a synthesis gas. similarly, synthesis gas must be upgraded before use, requiring removal of sulphurous gases and carbon dioxide, alteration of the hydrogen and carbon monoxide fractions, and treatment of the hydrocarbons that may be present. Alcohol separation has also been included in this volume because it involves the upgrading of a low-alcohol solution to hydrous or anhydrous alcohol and therefore, in concept, parallels the treament given to the other energy forms mentioned previously. The various unit processes considered in this volume have been defined in as discrete a fashion as the available data permits. For each of the generic types of upgrading processes, cost, power and other utility requirements as appropriate were assembled when available. 76 refs., 103 figs., 27 tabs.

50977 **(STEV—1987-R1) IEA Bioenergy annual report 1986.** (Statens Energiverk, Stockholm (Sweden)). 22 Jan 1987. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754441/JAW.

The report includes a final report for Task 1 as well as progress reports for the new Tasks 2-4. Task 1 covered biomass growth and production, short rotation forestry and storing forest biomass as well as cooperative activities on biomass conversion. The new tasks which were taken into operation in April 1986 have the following titles: -Improvement of biomass growth and production technology in short rotation forestry for energy. -Development of improved methods for harvesting, processing and transport of forest biomass for energy from conventional forests. -Improvement of methods for converting biomass feedstocks into useable energy forms. (G.B.).

50978 **(STEV—1987-R2) IEA Forestry Energy summary report 1978-1986.** Mitchell, C.P. (ed.). (Statens Energiverk, Stockholm (Sweden)). Mar 1987. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754442/JAW.

The objective was to develop a programme of cooperation and coordination in the planning and execution of national R and D programmes. The plans were concerned with growth and production; harvesting, processing and transport; conversion and systems analysis. Forestry energy is defined as the use of short rotation forestry biomass and forestry residues. Lists of cooperative projects and reports are included. (G.B.).

50979 **(STU—85-3497) Large scale cultivation of algae using Chinese technology modified for Swedish conditions.** Pedersen, M.; Haglund, K.; Bjoerk, M. (Uppsala Univ. (SE). Inst. foer Fysiologisk Botanik). (Swedish National Board for Technical Development, Stockholm). 26 Jun 1987. 9p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754449/JAW.

Studies in marine cultivation of macro-algae were performed at the Institute of Oceanology, Qingdao, China, Oct and Nov 1986. Production research was made parallell to evaluation of species of interest for cultivation in Sweden. Four species were brought to Sweden for continued studies and, possibly, use.

50980 **(WES—NOR-X-254) Impact of climatic variation on biomass accumulation in the boreal forest zone: selected references.** Peterson, E.B.; Peterson, M.M.; Kabzems, R.D. (Western Ecological Services (B.C.) Ltd., Sydney, British Columbia (Canada)). 1983. 362p. (420). (CE—01808). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The literature on relationships between climatic variables and growth rates of boreal tree species was reviewed from sources in North America, the USSR, and Scandinavia, with emphasis on Canadian information. An indexed, annotated bibliography provides background for a synthesis of climatic factors or processes that influence boreal biomass accumulation rates, nonclimatic factors or processes that influence boreal biomass accumulation rates, influence of boreal biomass burning on atmospheric carbon dioxide levels, boreal climate-biomass relationships, and knowledge gaps. Factors that influence growth rates of boreal tree species were grouped into those causing an increase in net primary productivity and those causing a decrease in productivity. Among the climatic factors, temperature-related variables exert more obvious controls over primary productivity in boreal forest ecosystems than do moisture-related variables. Forest productivity changes induced by climatic variation may be masked by the growth-controlling influences of topography (aspect), soil moisture and nutrients, ecological succession, and forest fire history. Among the many knowledge gaps pertaining to biomass/climate relationships, those of fundamental importance center around the linkages between fluctuating atmospheric circulation patterns and climatic conditions at regional and local levels. 329 refs., 9 figs., 4 tabs.

50981 **Effect of light-induced defects on the short wavelength quantum efficiencies of amorphous silicon solar cell structures.** Fortmann, C.M.; Lange, S.; Hicks, M.; Wronski, C.R. (Solarex Thin Film Division, Newtown-Yardley Road, Newtown, Pennsylvania 18940). *Journal of Applied Physics;* **64**: No. 8, 4219-4222(15 Oct 1988).

Light-induced defects in intrinsic hydrogenated amorphous silicon (a-Si:H) are found to have a large effect on the short wavelength quantum efficiencies (SWQE) of a-Si:H solar cell structures. The dependence of SWQE on cell structure thickness, volume absorbed bias illumination, and externally applied voltage has been studied. The results on thick cell structures (approx. >0.5 μm) can be explained by a simple model which yields light-induced defects with hole capture cross sections of about 10/sup -11/ —10/sup -12/ cm^2 and densities consistent with other measurements.

50982 **Excimer laser-processed oxide-passivated silicon solar cells of 19.5-percent efficiency.** Wood, R.F.; Westbrook, R.D.; Jellison, G.E. Jr. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN (US)). *IEEE Electron Device Letters;* **EDL-8**: No. 5, 249-251(May 1987).

Single-crystal p/sup +/ -n-n/sup +/ silicon solar cells with AM1.5 efficiencies exceeding 19.5 percent have been fabricated using glow-discharge implantation and pulsed excimer laser annealing, together with techniques for reducing the recombination current. These techniques include intrinsic passivation by thermal oxide growth and fine-line photolithography for metallization in order to reduce the area of metal-silicon contact. These are the highest efficiency ion-implanted nonconcentrator cells reported to date and to our knowledge they are the highest efficiency p-on-n cells made by any technique.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 50963, 50965, 50966, 50967, 50988, 51347

50983 **(EFN—26) Electricity production in the future.** Braun, J.; Lindstroem, O.; Lundgren, L.; Sigurd, D.; Stolt, L. (Energiforskningsnaemnden, Stockholm (Sweden)). Jan 1988. 230p. (In Swedish). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88754397/JAW.

The report describes five technologies for electric power generation, that may be of importance for power generation in the future: solar cells, fuel cells, thermoelectric- and thermionic devices, and MHD. (L.E.).

50984 **(PB—88-227376/XAB) Line-interactive inverters for photovoltaic cells and fuel cells.** Higa, O.; Kuniyoshi, M.; Shibata, T. (Toshibe Corp., Tokyo (Japan). Principal Office). 1988. 4p. NTIS, PC E04.

Included in Toshiba Review, Vol. 43, No. 4, 351-354(1988).

New energy sources such as photovoltaic cells or fuel cells are under development for power generation. However, the inverters used in coupling the cells with utility lines are a strong factor determining performance of the power-generation system. Described here are four types of inverters for photovoltaic/fuel cells. A 3-kW photovoltaic inverter, using high-speed switching devices, IGBTs (insulated gate bipolar transistors) and a digital controller with a sampling rate of 10 kHz, provides high-output and low-distortion of output current. A 100 to 1000-kW inverter for photovoltaic cells or fuel cells meets system requirements through use of

chopper-inverter configurations. A 12-MW, 18-pulse inverter for fuel cells uses 5-kV - 2.5-kA GTOs (gate turn-off thyristors) for high-efficiency and low-voltage distortion. A multi-microcomputer-based controller yields quick inverter response.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 50971, 50990

50985 Support and maneuvering device. Wood, R.L. US Patent Application 6-028,934. 1987. Filed date 23 Mar 1987. 30p. Contract AC02-83CH10093. NTIS, PC A03/MF A01.

A support and maneuvering device includes an elongated flexible inflatable enclosure having a fixed end and a movable end. The movable end is collapsible toward the fixed end to a contracted position when the enclosure is in a noninflated condition. Upon inflation, the movable end is movable away from the fixed end to an extended position. The movable end includes means for mounting an article such as a solar reflector thereon. The device also includes a plurality of position controlling means disposed about the movable end to effect adjusting movement of portions thereof by predetermined amounts and for controlling an angle at which the article disposed at the movable end is oriented. The plurality of position controlling means limits a suitable number degrees of freedom of the movable end for transmitting a steering motion thereto and for controlling the position thereof. 9 figs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 50996, 50996, 51485, 51492, 51502, 51503

50986 (AX/R—1-569) Solar energy in Canadian agriculture. Jackson, H.A. (Agriculture Canada, Ottawa, Ontario. Research Branch). Oct 1983. 115p. (In French). (CE—01797). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report covers fundamental aspects of solar energy as an available source, solar collectors and storage devices, and describes the applications of this energy to agriculture in Canada. The possibilities of these applications are evaluated and directions for future research are proposed. A number of projects financed by Agriculture Canada are examined. Most of these projects have to do with drying of crops and heating agricultural buildings. While there is not yet proof that solar drying can be applied profitably, solar heating has shown positive results. In the case of heating of stables, trials have indicated that preheating of ventilation air with the help of solar heating and storage units in south-oriented walls is economical in new construction. Retrofit applications need more research into the storage aspect. Results of greenhouse heating projects show that various techniques exist for improving solar heating capability, such as: reducing heat losses by installing fixed or movable insulation; and setting up dehumidification and heat exchange systems using the solar energy that the plants transform into nonusable latent heat by evapotranspiration. It is found that around 50% of the solar energy that enters a greenhouse is coverted into latent heat by plants. A list of finished research contracts, with a resume of each project, is appended. 18 refs., 33 figs., 2 tabs.

50987 (GMG—88) Solar refrigeration. Theakston, F.H. (Guelph Manufacturing Group (GMG), Ontario (Canada)). [1988]. 4p. (CE—01847; CONF-8804188—). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From 2. annual conference of the Association of Energy Management Analysts; Toronto, Canada (11 Apr 1988).

A refrigerator using solar energy to heat the boiler tube of an absorption refrigeration unit has been developed, with view to providing an effective, low-cost refrigeration method for use in developing countries. The solar collector used in the unit is a passive system, trapping energy in a glass vacuum tube. Radiation entering the collector is prevented from escaping by means of a tinted lining in the tube. A small-diameter metal tube, also vacuum sealed and containing a heat transfer fluid, is placed within the solar collector and carries heat to the boiler tube of the refrigerator where the refrigerant is boiled off to the evaporator coil, directly removing heat from the surrounding area in the freezing section. Often a reflector is used in conjunction with the collector to collect even more solar radiation. The unit has three backup power supplies to be used when solar radiation is not sufficient. It comes in a range of sizes from 2 cubic ft to walk-in units. The advantages of these refrigerators include quiet operation, no maintenance, continuous operation, and energy cost savings. The passive solar collector used in this unit can be easily adapted to other uses, such as water heating, cooking, drying, and air conditioning.

50988 (PB—88-219118/XAB) Preventing livestock water from freezing. Forest Service project record. McKenzie, D.W.; Kashuba, T.J.; Waddington, D.; Leboeuf, C.M.; May, E.K. (Forest Service, San Dimas, CA (USA). Equipment Development Center). Nov 1983. 23p. (PR—8322-1203). NTIS, PC A03/MF A01.

Available equipment for, and approaches to, preventing livestock water from freezing were surveyed in terms of water circulation, mass insulation, heat pipes, and solar energy. Use of insulated covers and applying insulation to the sides of stock tanks should be considered for ice-free stock water tanks. The propane bubbler seems the most simple and cost-effective freeze-prevention technique in climates that are not extreme. Photovoltaic-powered, water-circulation pumps appear to be practical and, because of their low cost, should be further investigated. Mass-insulated tanks are probably one of the simplest and most certain of the approaches presented for preventing freezing in livestock watering tanks. Heat pipes are an alternative to the propane bubbler that do not require a nonrenewable energy source. Photovoltaic cells to power an electric coil heater for freeze prevention in livestock stock tanks is impractical because of the high cost of the photovoltaic cells. Solar-heated (greenhouse effect), water-immersed, insulated tanks within a stock tank are considered excellent.

50989 (SLU-LBT—52) Solar drying of agricultural products. Bhide, V.G.; Takwale; M.G.; Pawar, R.S.; Henriksson, R.; Svensson, L. (Univ. of Poona, Pune (India); Swedish Univ. of Agricultural Sciences, Lund (SE). Dept. of Farm Buildings). (Swedish Univ. of Agricultural Sciences, Lund. Dept. of Farm Buildings). Jan 1987. 117p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754416/JAW.

Four different types of solar driers were designed and fabricated for the laboratory experiments for drying different agricultural products. By using these driers, comparative study of the drying process was done for bagasse, custard powder, sorghum, grapes and onion. From the experimental data, drying parameters were optimized for different products. The system efficiencies were between 16 and 30% depending on the product and the drying system used. Based on these data, field trial systems were designed for products such as custard powder, grapes and onion. These are: - Industrial drying system for custard powder with drying capacity 250 kg final product. This system is based on forced convection solar drying system and is operative for lasting two years. The performance data is presented in this report. - Natural convection solar drying system with 100 kg loading capacity for dehydration of onion and grapes. This system will be established by December 1986 at Sangali. The system details are given in the report. - Forced convection solar drying system with 500 kg loading capacity for dehydration of onion and grapes. This system will be established at NASIK. The system details are given in the report. These systems will be used for training the farmers with the help of farmers' cooperatives. Realizing the importance of drying of various agricultural products, the School of Energy Studies, University of Poona, Pune (India) and Department of Farm Buildings, Swedish University of Agricultural Sciences, Lund (Sweden) undertook jointly research and development of solar drying system for drying various agricultural products. (authors).

50990 **(TNO-TPD—627.025) Evaluation of Luigjes solar energy boiler.** Keizer-Boogh, E.M.; Kratz, P. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Jan 1987. 25p. (In Dutch). Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

The Luigjes Solar Energy Company developed a solar boiler system for the use in single-family dwellings. A general evaluation of the system was made by the Technical Physical Service (TNO, Delft, Netherlands) in cooperation with De Wit Consultants. The aim of this project is to determine the technical and production-technical feasibility of the boiler. Research has been done on reliability demands and energy conservation, possibilities to decrease costs or to increase energy conservation, possibility to replace an existing electric boiler by improving the storage reservoir. The reservoir was tested with regard to heating, tapping of hot water, and the thermal stratification. The test results of the storage reservoir were used to execute calculations with the help of the TPD-computer model. A sensitivity study has been done to investigate the variables that determine the annual yield of the system. A general evaluation of the solar energy boiler concerned the collector, the storage reservoir and the essential circuit. The executed heat storage tests are the heating test to determine the characteristics of the heat exchanger, loss of heat test during flow and during 24 hours rest, tap test (emptying reservoir), and layer disturbance test. De Wit Consultants evaluated the production-technical aspects: construction, method of production and insulation of the storage. 1 app., 7 figs., 2 tabs.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 50971

50991 **(IEA—8013770) Environmental factors of collector degradation: Task III, Performance testing of solar collectors.** Rogers, B.A. (University Coll., Cardiff (UK). Dept. of Mechanical Engineering and Energy Studies). Oct 1987. 46p. NTIS (US Sales Only), PC A04; 1; GPO Dep. Order Number DE88013770/JAW.

This report reviews the forms of material degradation observed in solar thermal collectors and the factors of the internal environment of the collector (moisture, ultraviolet radiation, etc.) which are the main causes of degradation. An account is then given of the methods used to quantify and measure both the degradation and the environment factors which effect the degradation. 103 refs.

50992 **(SP-RAPP—1987-26) Durability of sealants in solar collectors.** Eriksson-Widblom, K. (Statens Provningsanstalt, Boraes (Sweden)). 1987. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754439/JAW.

The serviceability of the sealing materials in a solar collector is of great importance. Extensive investigations have been carried out, mainly in the United States. They show that a large number of materials used has an ageing durability inadequate to the severe environmental conditions to which the collector is exposed. The materials used in Swedish made solar collectors are close to the best choice presented in these investigations. However, after accelerated ageing in laboratories for 26 weeks at 90 degrees C and 90% relative humidity (RH), none of these materials fulfills all the important criteria in a satisfactory way. In most cases the compression set was too high. In the report is given a summary of the results of the investigations found in literature, and the results from the investigations carried out on sealing materials used in Swedish solar collectors.

50993 **(TNO-TPD—603.004-II) Study into the relation between pressure and temperature in a collector system in case the pump in the collector circuit has broken down.** Wijsman, A.J.; Kortschot, D.J. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Oct 1986. 37p. Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

This study deals with the relation between the pressure setpoint of the safety valve in the collector circuit and the temperature of the header of a Philips VTR-261 collector after breakdown of the pump or the pump control in that circuit. A computer model was developed to study this effect. Also, experiments under the solar simulator were carried out. It was found, that the header of the Philips VTR-261 collector can be protected against extremely high temperatures by setting the pressure setpoint of the safety valve at about 2.5 ato. However, a practical solution to prevent fluid removal from the header, the water is pushed forward by the steam escaping through the safety valve, has yet to be found. For flat plate collectors the same method can be used. The pressure setpoint, however, depends on the efficiency curve of the solar collector. Also, the collector should be resistant to pressure. 1 app., 26 figs.

50994 **(TNO-TPD—614.014/614.015-1-34) Test of EBS-HP-collector/EES-solar boiler.** Kortschot, J.; Kratz, P.; Havinga, J. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Jan 1987. 22p. (In Dutch). Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

Under the authority of the Project Control Agency for Energy Research (PEO, Netherlands) measurements have been executed on the by EBS developed HP-collector and on the heat storage system of the EES solar boiler. The efficiency characteristics of the HP-collector were determined under the TPP solar simulator according to an international test procedure. Therefore the results of the measurements are reported in English. Characteristic for the collector is the applied double coverage: on the outside iron-free glass and on the inner side a tense tedlar foil. The tested solar boiler reservoir is meant to replace electric boilers. A feasibility study executed by the company EBS (now EES), concluded that the extra charges of such a reservoir compared to a conventional electric boiler are low. The decision was taken to elaborate and test the concept. The aim of testing the heat reservoir was determining heat losses during rest, electric heating and flow of the heat exchanger from the collector. The first part of this report discusses the testing of the solar boiler reservoir. The second part deals with the measurement results of the test of the HP-collector.

1420 Heat Storage

50995 **(CRIE—486006) Studies on temperature environment of experimental reclaimed land with fly ash.** Kosakai, Kazuyoshi; Okano, Toshiaki; Aoki, Kiyoshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1986. 13p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770154/JAW.

Experimental examination by a simulated reclaimed land was made on the temperature environment of the reclaimed land when a coal ash reclaimed land is used as an agricultural and grass land. Coal ash has higher thermal conductivity over the volcano ash soil, wherein the soil temperature in the dry condition rises deeper in the soil. As coal ash has higher rate of temperature wave propagation in addition to high thermal conductivity, it is conceivable to use a system of storing the solar energy under the ground as in the underground heat exchanger room. The effective utilization of coal ash and the coal ash reclaimed land may be proceeded not only in the agricultural industry, but also in other industries by utilizing its physical properties, as thermal storage or releasing materials. (7 figs, 2 tabs, 4 refs)

50996 **(TNO-TPD—403.346) Monitoring the Groningen solar energy system with seasonal heat storage in the soil. Collected CEC progress reports.** Wijsman, A.J.; Kortschot, D.J. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Feb 1987. 92p. Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

The TNO Institute of Applied Physics (TPD) conducted a monitoring program on the Groningen solar energy system, which consists of 96 solar houses with a central heat store in the soil. The actual monitoring of the system started on February 1, 1985, and lasted until January 31, 1987. The monitoring activities were reported periodically to the CEC (Commission of the European Communities) in five progress reports, which have been collected

in this report. Each report gives information about the activities over a certain period (September 15, 1984-January 31, 1987), the measuring results over that period and the planning of the activities for the next period. The two years monitoring results will be presented in a final report (TNO-TPD-403.346, entitled 'Monitoring of the Groningen solar energy system with seasonal heat storage in the soil. Final report'). The monitoring program is ment to measure the total heat consumption (space heating and domestic hot water) and the total heat gain by the solar collectors of each block of houses (9 blocks). Of 6 houses in one block the heat consumption for space heating and domestic hot water are measured separately. At the boiler house the total heat consumption for the group of houses, the total heat gain by the collectors, the heat supply to the storage system, the heat withdrawal from the storage system and the heat supply by the gas boiler are measured.

15 GEOTHERMAL ENERGY

50997 **(CONF-880477—) Beyond goals and objectives: Geothermal Program Review VI: Proceedings.** (Meridian Corp., Alexandria, VA (USA)). 1988. 189p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88015148/JAW.

From 6. DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

Program Review VI was comprised of six sessions, including an opening session, four technical sessions that addressed each of the major DOE research areas, and a session on special issues. The technical sessions were on Hydrothermal, Hot Dry Rock, Geopressured and Magma resources. Presenters in the technical sessions discussed their R and D activities within the context of specific GTD Programmatic Objectives for that technology, their progress toward achieving those objectives, and the value of those achievements to industry. The "Special Issues" presentations addressed several topics such as the interactions between government and industry on geothermal energy R and D; the origin and basis for the programmatic objectives analytical computer model; and international marketing opportunities for US geothermal equipment and services. The unique aspect of Program Review VI was that it was held in conjunction with the National Geothermal Association's Industry Round Table on Federal R and D. The Round Table provided a forum for open and lively discussions between industry and government researchers and gave industry an opportunity to convey their needs and perspectives on DOE's research programs. These discussions also provided valuable information to DOE regarding industry's priorities and directions.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 50749

50998 **(AV/P—8310) A preparatory study for application of geothermal energy in the Hinton/Edson area of Alberta. Final report.** Jones, F.W.; Rahman, M.; Lam, H.L.; Sworder, J.E. (Alberta Univ., Edmonton (Canada). Dept. of Physics). 31 Oct 1983. 302p. (CE—01811). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A survey of possible geothermal energy use in Alberta has been undertaken, with particular emphasis on the Hinton/Edson area in Alberta. Petroleum exploration well records from the Hinton/Edson area have been reviewed to determine the suitability of existing wells for geothermal energy extraction. Generally, it has been found that a specific project must be proposed before really meaningful results can be expected from such a survey. Also, it appears that conception and planning of a geothermal installation as such from the beginning may be a better way than to try to use existing wells. A more general survey of potential uses of geothermal energy in Alberta was undertaken, and a number of possible uses, such as greenhouse heating are suggested. One in particular, the Bowden Correctional Institute, appears promising, and some detailed work has been done to assess its viability. Computer modelling of a geothermal well doublet and related aquifer flow was undertaken and a catalogue of results is presented. In addition, a sumary of results from the assessment of the low-grade geothermal energy potential in the Hinton/Edson area is presented. 15 refs., 65 figs., 21 tabs.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 52052

50999 **(CRIE-U—86020) Geochemical survey tracer experiment during initial closed-loop flow Test (ICFT).** Kanaori, Yuji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1987. 30p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770173/JAW.

The Initial Closed-Loop Flow Test (ICFT) was performed at Fenton Hill, New Mexico (USA) during 30 days in May, 1986. The objective is to extract heat from deep-seated, hot dry rock reservoir formed by hydrofracturing. The results are as follows. (1) The dry gas composed predominantly of carbon dioxide (more than 90% by volume). The concentration of dissolved CO_2 in the fluid declined from the initial 1% to a nearly steady state level of 0.1 - 0.2 % by weight. (2) Chemical composition of the gas changed much during the first 3 days, but settled down to a steady level except some special periods. Behaviors of elements were threefold: B and CL, etc. which is originally of constant concentration, but is diluted by the reinjected water: Si which is always at constant level of concentaration: Mg, etc. which reduces its concentration considerably due to the adsorption to the rock surfaces. (3) The radioactive tracer experiments suggested that the reservoir fracture volume was growing by time. (16 figs, 5 refs)

51000 **(DOE/SF/16299—H1) Geothermal innovative technologies catalog.** Kenkeremath, D. (ed.). (Meridian Corp., Alexandria, VA (USA)). Sep 1988. Contract AC03-86SF16299. 187p. NTIS, PC A09/MF A01. Order Number DE88017226/JAW.

The technology items in this report were selected on the basis of technological readiness and applicability to current technology transfer thrusts. The items include technologies that are considered to be within 2 to 3 years of being transferred. While the catalog does not profess to be entirely complete, it does represent an initial attempt at archiving innovative geothermal technologies with ample room for additions as they occur. The catalog itself is divided into five major functional areas: Exploration; Drilling, Well Completion, and Reservoir Production; Materials and Brine Chemistry; Direct Use; and Economics. Within these major divisions are sub-categories identifying specific types of technological advances: Hardware; Software; Data Base; Process/Procedure; Test Facility; and Handbook.

51001 **(GSJ—266) Research in the Sengan geothermal area.** (Geological Survey of Japan, Yatabe, Ibaraki). 25 Mar 1987. 596p. (In Japanese). Geological Survey of Japan, 1-3, 1-chome, Higashi, Yatabe-machi, Ibaraki-ken, Japan.

This research and investigation aim at promoting the development of wide area and large scale deep geothermal resources, and taking the Sengan geothermal area as a model field, and applying the exploration techniques accumulated so far to it, this is to verify the techniques and evaluate the field as a geothermal resource. This report is a part of Verification and Investigation of Geothermal Exploration Techniques and Other which has been jointly advanced by the Geological Survey of Japan (GSJ) and New Energy Development Organization since 1980 as a part of the Sunshine Project, and is the results obtained by the GSJ. The GSJ was in charge of geological and geochemical surveys and the data analysis, and carried out the verification of geological and geothermal structures, reservoir structure, hydraulic structure, and the effectiveness of appying geothermal exploration techniques, and the examination of data analysis method. In 1987, the investigation enters the final stage, and it is intended to drill a 3,000 m class depth exploratory well on the north side of Akita Yakeyama. (323 figs, 71 tabs, 8 photos, 610 refs)

51002 (GSJ—8701, pp 183-186) **Research of radioactive dating methods (Fy 1985).** Tamao, Shiro. (New Energy Development Organization, Tokyo, Japan). Jan 1987. (In Japanese). NTIS (US Sales Only), PC A11. Order Number DE88770074/JAW.

In Research on prospecting techniques for deep geothermal resources.

In order to assess heat sources in geothermal areas from the stand point of the history of volcanic activities, radioactive dating of volcanic rocks younger than one million years old must be conducted with good accuracy. In FY 1985, NEDO tried to make technological development of the α-recoil track method and the ionium method as new measuring methods and also conducted dating by the modified K-Ar method and the FT method for cross-checking. As the result, with respect to the α-recoil track method, detection of α-recoil tracks was tried to no avail utilizing a zircon crystal with a phase contrast microscope. By the application of the ionium method, the Iida pyroclastic flow in the Hohi geothermal area was dated around 40,000 years old and the Aso-3A pyroclastic flow around 120,000 years old. These figures coincided very well the dating values by the K-Ar method and the FT method. However, concerning the Miyagi pyroclastic flow, etc., no isochron was obtained. With regard to the Aso-4 pyroclastic flow and the Dakeyu pyroclastic flow in the Hohi area as well as the Yakeyama Onigashiro lava in the Hachimantai area, dating by the ionium method is in progress. (2 tabs)

51003 (GSJ—8701, pp 187-190) **Study of magma temperature measuring method (1985).** Sudo, Shigeru; Okumura, Kimio; Matsubayashi, Osamu. (Geological Survey of Japan, Ibaraki, Japan). Jan 1987. (In Japanese). NTIS (US Sales Only), PC A11.

In Research on prospecting techniques for deep geothermal resources.

It is important to obtain informations of a magma reservoir which is quite potential geothermal source of a volcanic region. In this report, a pyroxene method to calculate the temperature at which two types of augite crystallized out from an equilibrium condition from magma was adopted and applied to the volcanic rocks in the Sengan geothermal districts. According to the result of chemical analysis of rocks, two newest volcanoes, Mt. Akita-Komagatake and Mt. Iwateyama, consisted of basalt and andesite, and other new volcanic rocks consist of basalt accompanied by a small amount of dacite and trace amount of rhyolite. A geological map of the district was prepared and the relation between the geological structure and distribution of spring and blow-out was clarified. Thermal source of this district is a giant complex of a magma reservoir of felsic mineral, which blew out at 2 Ma and 1 Ma, and a magma reservoir of andesite which blew out sporadically during the last 3 million years. (10 refs)

51004 (GSJ—8701, pp 191-205) **Study on pressure gauge for volcanic rocks.** Sasada, Masakatsu. (Geological Survey of Japan, Ibaraki, Japan). Jan 1987. (In Japanese). NTIS (US Sales Only), PC A11.

In Research on prospecting techniques for deep geothermal resources.

This is a report of the study in 5 years till 1985 on the development of a method to obtain temperature and pressure conditions of a magma reservoir and a geothermal reservoir by utilizing various inclusions produced in the geothermal districts. The primary result is the establishment of a method to obtain the pressure conditions of geothermal fluid from the fluid inclusions. This method is to judge whether the pressure condition of the fluid is hydrostatic pressure or rock pressure from the relation of CO_2, which is a most abundant non-condensible gas among the geothermal fluid, and the boiling curve of water. A method of measuring CO_2 concentration semi-quantitatively by means of a crush stand was also devised, for example, for obtaining the condition of calcite scale formation. For a geothermal district with simple thermal history, a method of comparing the present ground temperature and the minimum value of the uniformizing temperature can be applied. (12 figs, 1 tab, 7 refs)

51005 (GSJ—8701, pp 207-299) **Study on thermal history of hot dry rock mass.** Takeno, Naoto; Kanehara, Keiji. (Geological Survey of Japan, Ibaraki, Japan). Jan 1987. (In Japanese). NTIS (US Sales Only), PC A11.

In Research on prospecting techniques for deep geothermal resources.

This report consists of 3 parts. (1) Study of rock alteration by numerical simulation. (2) Study of thermal history by thermal luminescence. (3) Study of hydro-thermal reaction velocity of rocks (Summary). Following items are described in (1). Properties of natural neutral and alkaline geothermal fluid. Geothermal fluid model. It is important, in the consideration on the alteration of geothermal regions, to clarify how the hot water flows and develops in the temperature field. In (2), samples of 2,000 m depth of Tohoku Sen-Gan area was measured clarifying that the timing of the thermal luminescence could be reset at considerably low temperature. In (3), development of measurement method for obtaining the age of altered rocks and volcanic rocks, and expansion of applicable range were carried out as well as the application and evaluation for the typical geothermal areas. (17 figs, 2 tabs, 28 refs)

51006 (IZ—8601, pp 15-21) **Geothermal reservoir of the Taketomi-jima submarine hot spring in Okinawa, Japan.** Kimura, Masaaki; Hayashi, Masao; Omori, Tamotsu; Kawana, Toshio. (Univ. of the Ryukyus, college of Science, Naha, Japan;Research Inst. of Industrial Science Kyushu Univ., Fukuoka, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

To determine whether the heat source of the submarine hot spring located offshore Taketomi-jima in Okinawa Pref., Japan is volcanic or not, the submarine gas and spring water were collected and analyzed in December, 1982; the results of chemical analysis were reported previously. This time, the temperature and heat source of the geothermal reservoir were studied. The well mouth of the Taketomi-jima submarine hot spring is located in lat. 24°N, long. 124°E, and is open on a flat 13 to 20 meters below the sea level. Gas and hot water are welling from between sand rock blocks. The most active welling port is located about 22.5 meters below the sea level. The collected spring water was mixed with seawater immediately. The percentages of seawater (S) and hot spring water (H) are assumed to be 93% (S) and 7% (H). The temperature of the geothermal reservoir is estimated to be 191°C. This temperature indicates that the heat source is volcanic and suggests that it can be used as geothermal energy in the future. (4 figs, 3 tabs, 9 refs)

51007 (MMIJ—8801, pp 55-56) **BHTV observation and hydraulically fractured cracks at Hijiori HDR-1 well.** Matsunaga, Takeshi; Ito, Hisao; Miyairi, Makoto. (National Research Inst. for Pollution and Resources, Tsukuba, Japan; Geological Survey of Japan, Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

In Oct., 1986, NEDO carried out hydraulic fracturing for the formation of artificial geothermal reservoir at Hijiori District, Okura-mura, Yamagata Prefecture. 1,080 m^3 of water was injected into a well bottom at 1,800 m depth and 3,700 m^3 hot water (105°C) were recovered. In 1987, the condition of fracture generation was examined by BHTV (Bore Hole Tele Viewer) observation and the flow detection of the hydraulically fractured well. And a new well was drilled to confirm the direction of the fracture. In this report, a relation between the hydraulically fractured cracks and the natural cracks were considered on the basis of BHTV observation on the two wells. It was made clear that the hydraulic fracturing of 1986 generated a vertical crack along the new well axis. (5 figs, 1 tabs, 2 refs)

51008 (MMIJ—8801, pp 57-58) **Propagation characteristics of micro-wave range electromagnetic wave in the non-uniform rock specimens.** Kitahara, Yoshiya. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Development of a means to remote-detect the cracks or capacity or the existence of boundary surface of different rocks in the rock base is concerned from the viewpoints of fracture confirmation or stbility of underground rocks for the purpose of geothermal development, Such elastic waves as ultrasonic wave and AE can be considered but are not yet complete. This report examined a method to detect the abnormalities, utilizing the electromagnetic wave of the microwave range, from the reflective, refractive and scattering properties caused by the difference of dielectric properties. The wave used was a pulse wave of 3200 MHz. Test items were as follows. Reflection of pulse wave due to the gap in the rocks. Pulse wave transmitted through the boundary surface of different rocks and gaps. Transmission and reflection of pulse wave through the rocks with a cavity. Detection by means of transmitting wave amplitude through a metal pipe in the water. As the present system is a non-contact detection, utilization of a CT treatment can be expected. (6 figs)

51009 (MMIJ—8801, pp 71-72) **Response analysis of gas tracer in the penetration flow which accompanies boiling.** Shinbori, Yuichi; Wajima, Nobuhisa; Senda, Kitsu. (Tohoku Univ., Faculty of Engineering, Sendai, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

A tracer test which is conducted at the geothermal development area is regarded a powerful means of grasping the mutual relations of production and reinjection wells. This study is a basic laboratory research wherein a responce of a gas tracer in the penetration flow accompanying the boiling was analyzed. In other words, experiment was made in the portion changing from single phase flow to dual-phase flow and the obtained result was applied with a gas-liquid dual phase model. The result is that this mathematical model could give the information on the saturation ratio and pressure distribution in the reservoir from the vapor ratio of the productive fluid and the minimum arrival time of the gas tracer. (3 figs, 2 tabs, 3 refs)

51010 (UCRL—53615-86, pp 47-50) **Research.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The primary mission of the Research Group is to expand the basic research opportunities available to scientists in the Earth Sciences Department. Current activities are distributed across two major programs: Office of Basic Energy Sciences Geosciences Program (BES) and the Laboratory Institutional Research and Development Program (IR & D). In addition, the Institute of Geophysics and Planetary Physics (IGPP) provides a vehicle for interactions with other research institutions in the University of California system. This paper highlights activities of four programs (IGPP, IR & D, OBES, and Geothermal) supported by members of the group. Recent publications are listed. 33 references.

1504 Legal And Institutional Aspects

REFER ALSO TO CITATION(S) 50653

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 51000

1508 Geothermal Power Plants

51011 **(EGG-M—88131) Improving the efficiency of binary cycles.** Mines, G.L.; Bliem, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 6p. (CONF-880477—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015108/JAW.

From 6. DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

The performance of binary geothermal power plants can be improved through the proper choice of a working fluid, and optimization of component designs and operating conditions. This paper summarizes the investigations at the Idaho National Engineering Laboratory (INEL) which are examining binary cycle performance improvements for moderate temperature (350 to 400 F) resources. These investigations examine performance improvements resulting from the supercritical vaporization and countercurrent integral condensation of mixed hydrocarbon working fluids, as well as the modification of the turbine inlet state points to achieve supersaturated turbine vapor expansions. For resources, with the brine outlet temperature restricted, the use of turbine exhaust recuperators is examined. The reference plant used to determine improvements in plant performance in these studies operates at conditions similar to the 45 MW Heber binary plant. The brine effectiveness (watt-hours per pound of brine) is used as an indicator for improvements in performance. The performance of the binary cycle can be improved by 25 to 30% relative to the reference plant through the selection of the optimum working fluids and operating conditions, achieving countercurrent integral condensation, and allowing supersaturated vapor expansions in the turbine. 9 refs., 5 figs.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 50832, 51000, 51011, 51492, 51492

51012 **(EGG-M—88140) Optimizing reservoir management through fracture modeling.** Renner, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 4p. (CONF-880477—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015107/JAW.

From 6. DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

Fracture flow will become increasingly important to optimal reservoir management as exploration of geothermal reservoirs continues and as injection of spent fluid increases. The Department of Energy conducts research focused on locating and characterizing fractures, modeling the effects of fractures on movement of fluid, solutes, and heat throughout a reservoir, and determining the effects of injection on long-term reservoir production characteristics in order to increase the ability to predict with greater certainty the long-term performance of geothermal reservoirs. Improvements in interpreting and modeling geophysical techniques such as gravity, self potential, and aeromagnetics are yielding new information for the delineation of active major conduits for fluid flow. Vertical seismic profiling and cross-borehole electromagnetic techniques also show promise for delineating fracture zones. DOE funds several efforts for simulating geothermal reservoirs. Lawrence Berkeley Laboratory has adopted a continuum treatment for reservoirs with a fracture component. Idaho National Engineering Laboratory has developed simulation techniques which utilize discrete fractures and interchange of fluid between permeable matrix and fractures. Results of these research projects will be presented to industry through publications and appropriate public meetings. 9 refs.

51013 (MMIJ—8801, pp 343-344) **Elution behavior into the high pressured hot water and the organizational change of granite and andesite.** Matsunaga, Isao; Miyazaki, Akira; Yamaguchi, Tsutomu; kuriyakawa, Michio. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

In the development of a high temperature rock system, the interaction between the rock and hot water which occurs in a reservoir provides big effects. The decline of the strength and the increase of the permeability are caused by the elusion of the rock on the surface of the hydraulic fracture and the redeposition of the eluded material also causes to narrow or close the channel. However, studies concerning the organizational change of the rock by the hot water or the material change associated with the organizational change are small in number. In this research, Inaba granite and Honkomatsu andesite were treated in heat with an autoclave in order to investigate the organizational changes of the rocks and at the same time, the elusion behavior of the rocks into the hot water was investigated by examining chemical components which were

eluded into the fluid and the components remaining on the rock surface. The decreased amount per specific surface area due to the autoclave treatment is the order of $10^{-3}(gcm^{-2})$ for both rocks and changeable depending upon the heating temperature and the kind of rock. As a result of the analysis of the fluids in the autoclave after the heat treatment, the Si concentration of Honkomatsu andesite was higher in the same temperature and the heating time. (2 figs, 3 tabs, 6 refs)

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 50998

51014 **(LA—11326-MS) A survey of geothermal process heat applications in Guatemala: An engineering survey.** Altseimer, J.H.; Edeskuty, F.J. (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 75p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016195/JAW.

This study investigates how process heat from Guatemala's geothermal energy resources can be developed to reduce Guatemala's costly importation of oil, create new employment by encouraging new industry, and reduce fuel costs for existing industry. This investigation was funded by the US Agency for International Development and carried out jointly by the Guatemalan Government and the Los Alamos National Laboratory. Two sites, Amatitlan and Zunil, are being developed geothermally. Amatitlan is in the better industrial area but Zunil's geothermal development is more advanced. The industry around Zunil is almost exclusively agricultural and the development of an agricultural processing plant (freezing, dehydration, and cold storage) using geothermal heat is recommended. Similar developments throughout the volcanic zones of Guatemala are possible. Later, when the field at Amatitlan has been further developed, an industrial park can be planned. Potential Amatitlan applications are the final stage of salt refining, a thermal power plant, hospital/hotel heating and cooling, steam curing of concrete blocks, production of alcohol from sugar cane, and production of polyethylene from ethanol. Other special developments such as water pumping for the city of Guatemala and the use of moderate-temperature geothermal fluids for localized power production are also possible. 12 refs., 13 figs., 14 tabs.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 50999, 51005

51015 (MMIJ—8801, pp 345-346) **Dynamical characteristics of rocks in high temperatures.** Kyo, Sosuke; Kiyohashi, Hiroshi; Sekiguchi, Ryuichi; Matsushita, Yusuke. (Tohoku Univ., Faculty of Engineering, Sendai, Japan; Kumagai Gumi Co., Ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

In this research, five kinds of rocks (two kinds of granites, sandstone, andesite and tuff) were used, and hot uniaxial compression tests as well as hot radial compression and tension tests were conducted using rock samples preheated at the preset temperatures in the range between the room temperature and 600°C. During the uniaxial tests, the longitudinal strains were measured at the same time and the Young's moduli were obtained. The shear strength was calculated by the Kobayashi-Okumura formula using the measured values of the compressive strength and the tensile strength. From the above experimental results, the relationships between various natures of the samples used in this experiment and the temperatures were clarified. Concerning the relationship between the compressive strength and the temperature, the strength decreased as the temperature increased in case of granite, but in other rocks, no change was observed except tuff which showed a slight decrease of the strength. With regard to the tensile strength, granite and andesite showed the decrease of the strength as the temperature increased, but other rocks showed small changes only. The shear strength was the same as the tensile strength. Concerning the Young's modulus, it increased as the temperature went up in case of andesite and sandstone, but it decreased in case of granite and showd almost no change in case of tuff. The decrease of the strength of granite is due to quartz in it. (6 figs, 6 refs)

51016 (MMIJ—8801, pp 347-348) **Compression fracturing characteristics of rocks in the high temperature and high pressured water environment.** Kojima, Takashi; Matsumoto, Masashi; Matsuki, Koji; Takahashi, Hideaki. (Tohoku Univ., Faculty of Engineering, Sendai, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

In connexion with the technological development on the treatment of high level nuclear wastes in the deep rock bed and the geothermal development, elucidation of the fracturing characteristics of the rocks in the high temperature and high pressured water environment is being hastened. In this research, following the first report in 1987, the dependability of rate of strain of the compression fracturing characteristics was studied through the compression tests within the wide range of rate of strain (10^{-3}-$10^{-8}S^{-1}$) in the autoclave (temperature 200°C and sealed pressure 10MPa) using granite which was one of the subject rock beds for the development. The rock used for the test was Inaba granite. As the result of the above study, it was revealed that the compressive strength of Inaba granite in the water of 200°C and in the water of the room temperature decreased as the rate of strain declined and at the critical rate of strain or below, kept a constant value (the lowest limit). It was shown through experiments and the microcrack model designed by Costin that this trend could be explained by the stress corrosion crack of micro fractures. It is very important for designing a rock bed structure in a long range that the compressive strength has the lowest limit. (4 figs, 1 ref)

16 TIDAL AND WAVE POWER

1605 Environmental Aspects

REFER ALSO TO CITATION(S) 50937

1608 Wave Energy Converters

51017 **(ETSU-WV—1508-Pt.3) Development of the NMIWAVE computer program to calculate wave loading and response motions of wave energy devices. Part 3 of Project Report 302010.** (UKAEA Harwell Lab. Energy Technology Div.; National Maritime Inst., Feltham (UK)). Jan 1981. 11p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The NMIWAVE computer program has been developed to calculate wave loading and response motions of various wave energy devices. Existing hydrodynamic programs were extended to accommodate multiple-body degrees of freedom. Two new response programs, applicable to Salter duck, Cockerell raft and similar devices, were also developed. These programmes, their validation and use are described in a series of detailed reports and papers. This final report on the project is no more than a brief summary, outlining the main achievements and landmarks during the course of the project, and describing the basic theoretical assumptions and method.

51018 **(ETSU-WV—1512-Pt.3B) Edinburgh wave power project. Fourth year report. Volume 2 of 3.** (UKAEA Harwell Lab. Energy Technology Div.; Edinburgh Univ. (UK)). Jul 1978. 44p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The behaviour of ducks in extreme conditions was examined, and the largest, steepest wave possible was generated in the narrow tank. Mounting compliance, position, power take-off and attitude of the model was varied, and forces and movements were measured and a sequence of photographs was taken.

51019 **(ETSU-WV—1512-Pt.3C) Edinburgh wave power project. Fourth year report. Volume 3 of 3.** (UKAEA Harwell Lab. Energy Technology Div.; Edinburgh Univ. (UK)). Jul 1978. 21p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The behaviour or ducks in extreme conditions was examined, and the largest, steepest wave possible was generated in the narrow tank. Mounting compliance, position, power take-off and attitude of the model was varied, and forces and movements were measured and a sequence of photographs was taken.

51020 **(ETSU-WV—1518-P3) Wave energy programme feasibility study on a submerged resonant duct.** (UKAEA Harwell Lab. Energy Technology Div.; Vickers Ltd., Eastleigh (UK). Design and Projects Div.). Nov 1977. 85p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Results of a feasibility study into the wave energy converter device known as a submerged resonant duct are reported. Both experimental and theoretical results are presented. Topics covered include the estimation of full scale power extraction, computer simulation and wave tank tests. The conclusions and suggestions for further work are presented.

51021 **(ETSU-WV—1518-P7) Tests with devices to extract energy from waves. Stage 2.** King, R.; Every, M.J. (BHRA Fluid Engineering Centre, Cranfield (UK)). (UKAEA Harwell Lab. Energy Technology Div.; BHRA Fluid Engineering Centre, Cranfield (UK)). Mar 1977. 23p. (BHRA-FEC-TRC—1092). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Report prepared for Vickers Ltd., Eastleigh (GB). Design and Projects Div.

Experimental test results are presented for two models of devices which might be used to extract energy from waves. The two devices were a half U-tube into which damping orifice plates were introduced into the resonant tube and a half U-tube with the oscillating water in the vertical limb spilt into the collecting vessel. A maximum apparent efficiency of up to 30% was achieved at low wave amplitudes. A method of flow rectification has also been demonstrated.

51022 **(ETSU-WV—1520-P1) Sea state measurement from an airborne altimeter and a waverider buoy in an area west to the Isles of Scilly. Concluding report.** Young, M.R.A. (Flight Refuelling Ltd., Wimborne (GB)). (UKAEA Harwell Lab. Energy Technology Div.; Flight Refuelling Ltd., Wimborne (UK)). Nov 1979. 40p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The results of trials flown over seas up to state 7 and peak wave heights in excess of 30 feet are presented. A Rushton target equipped with a radar altimeter and associated equipment data processing, transmission and recording system was used. All sorties were flown at an aircraft speed of 250 knots with a target height 50 feet above the sea.

51023 **(ETSU-WV—1527-Pt.1) Examination of the proposal by G.E.C., R.E.L. for an investigation of variable to fixed frequency conversion equipment for wave energy applications.** (UKAEA Harwell Lab. Energy Technology Div.; International Research and Development Co. Ltd., Newcastle upon Tyne (UK)). Sep 1979. 28p. (IRD-TM—79-341A). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This report reviews the merits of using induction generators utilising slip energy recovery, on wave energy converters, and briefly examines how the capital cost and conversion losses of the proposed systems compare with those of the present preferred scheme. If H.V.D.C. transmission is used then the analysis suggests that the proposed systems suffer from all the disadvantages of using induction generators, coupled with additional capital cost and reduced conversion efficiency due to the additional power conversion stages. If a.c. transmission to shore is used then except for the most elementary scheme proposed the capital cost is equal to or greater than that of the preferred generation and d.c. transmission scheme. With schemes 1, 2 and 3 the average conversion efficiency is less than that of the preferred scheme, while with scheme 4 it is equal to that of the preferred scheme. The use of induction generators in an a.c. system at sea would also result in stability problems, extra maintenance and possibly difficulty in obtaining rapid fault clearance and recovery.

51024 **(ETSU-WV—1533-Pt.2) Final report on marine fouling off the West Coast of Scotland.** Picken, M.J.; Fitzgerald, G.M.F. (UKAEA Harwell Lab. Energy Technology Div.; Scottish Marine Biological Association, Oban (UK). Dunstaffnage Marine Research Lab.). Feb 1982. 91p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The study of marine fouling in the Hebridean wave energy area commenced in 1978. This was extended in 1980 and 1981 with further assessments of fouling on offshore structures, such as navigation buoys, off other parts of the west coast of Scotland. Structures placed in the sea off the Outer Hebrides are likely to be affected mainly by the settlement and growth of mussels and kelps. In addition a wide range of other animal and plant species can be expected. Species diversity and performance of the principal species are governed by geographic and hydrographic parameters. Geographic isolation is likely to have only a transient effect in delaying colonisation. The experimental and survey results are summarised with reference: (i) to taxonomic classification; (ii) classification into fouling groups based on physical affinities. Tentative predictions of fouling levels on several wave energy devices are made. Refinement of device designs since 1978 has minimised the effects of fouling however specific effects are discussed and prevention methods reviewed. The appendices include a short materials discussion and a detailed current technical review of some biocides for use in hydraulic transmission systems.

51025 **(ETSU-WV—1551-Pt.1a) Extraction of power from sea waves. Interim report-1979. Summary.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Dec 1979. 20p. (WP—119). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Development studies on the Cockerell Raft have shown that this wave energy system could be completed for a cost of Pound 4.0 million per device, and that such a system might generate power at 9p per kw/hr. Similar studies on the Lancaster Flexible Bag have lead to a system which could also be completed for a cost of Pound 4.0 million per device, and that such a system might generate power at 4.0p kw/hr. Because little model work has been done in 1979 the power outputs of these systems cannot be predicted with the same confidence as their cost. In parallel with these engineering studies Wavepower Limited has been constructing a wide wave tank, and has been developing a powerful computer controlled wavemaking and data processing system capable of supporting an intensive experimental programme. This facility will be available for use by the Wave Energy community in 1980.

51026 **(ETSU-WV—1551-Pt.1c) Extraction of power from sea waves. Interim report - 1979. Drawings.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Dec 1979. 18p. (WP—119). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

These drawings are associated with development studies on the Cockerell Raft and the Lancaster Flexible Bag wave energy converters for use at a potential site in the Outer Hebrides. Drawings relating to low press and high pressure seawater pumps, concrete hulls, general raft lay-out and mooring are included for the raft project. For the Lancaster Bag, the drawings relate to offshore power station lay-out, general arrangement and construction details and air turbines.

51027 **(ETSU-WV—1551-Pt.14) Construction in concrete of the one hinged raft, low and high pressure and the preparation of budget cost estimates. Report to Wavepower Limited.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK); McAlpine (Sir Robert) and Sons Ltd., London (UK)). Nov 1979. 17p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The development of the wave power converter device known as a one hinged raft has resulted in two alternative designs. The first is a low pressure system incorporating a turbine generator on the raft and trailing electrical cable to be sea bed. The second is a high pressure system in which seawater is pumped by the raft through a flexible pipe to a sea bed bus main. Outline designs and budgetry cost estimates are presented.

51028 **(ETSU-WV—1551-Pt.16) Extraction of power from sea waves. Interim report - 1979.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Dec 1979. 290p. (WP—119). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A comprehensive report is given of development studies on the Cockerell Raft and Lancaster Flexible Bag wave energy converters. The studies include the construction of the devices, model testing facilities, mooring, power generation and transmission, cost estimation and site location off the coast of Scotland.

51029 **(ETSU-WV—1551-Pt.22) Cost projections for Cockerell rafts presented to ACORD January 1979.** (UKAEA Harwell Lab. Energy Technology Div.; Wavepower Ltd., Southampton (UK)). Jan 1979. 15p. (WP—115). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This report outlines the underlying thinking and assumptions behind the expectation that the electricity generation cost projections for the wave energy conversion devices known as Cockerell rafts can be reduced from 25 to 6.6 p/Kwh. This reduction is expected from optimization of the design and the exploitation of the benefits of volume production.

51030 **(ETSU-WV—1551-Pt.33) Assessment of candidate materials for non-return valves intended for use in Lancaster Flexible Bag wave energy converter.** (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Jul 1981. 25p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The existing design of non-return valve, is evaluated from the metallurgical standpoint, and alternative material suggestions are offered, with the objective of incorporating improvements in the design. In essence, the design parameters are based on a 25 year life with a minimum maintenance interval of 5 years for purposes of major overhaul. Within that 5 year period it is anticipated that the device will experience 16 x 10/sup 6/ operational cycles based on a wave front periodicity of 10 seconds.

51031 **(ETSU-WV—1551-Pt.35) Construction of air turbines for use in Lancaster Flexible Bag wave energy converter device: a pre-design materials assessment.** McQueen, S.S. (Y-ARD Ltd., Glasgow (UK)). (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). Sep 1981. 56p. (YR—3802/81). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

In assessing the suitability of materials intended for the various components in an air turbine operating in a marine environment within the Lancaster Flexible Bag Device, this memorandum puts forward a choice of alternative material routes for consideration by the design team. These alternatives differ in their philosophy since for one route the use of relatively costly corrosion resistant steels is suggested for some rotating components, whilst the other choice advocates the use of low cost materials for these components. With regard to the first route, the use of the Duplex stainless steels for turbine disc and rotor blades is proposed to avoid the possibility of stress corrosion cracking occurring with the austenitic type of corrosion resistant stainless steels in the presence of the chloride ion. Such stress corrosion cracking is possible if the operating temperature of the air in the closed loop exceeds about 60/sup 0/C for protracted intervals of time.

51032 **(ETSU-WV—1551-Pt.396) Power transmission study for a wave energy scheme based on Lancaster Flexible Bag devices. V.2. Appendices.** (UKAEA Harwell Lab. Energy Technology Div.; Preece, Cardew and Rider, Brighton (UK); Wavepower Ltd., Southampton (UK)). Nov 1981. vp. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This report contains the Appendices to the main report of a power transmission study for a wave energy array based on the conversion devices known as the Lancaster Flexible Bag. The appendices contain information on budgetry prices, technical details for the various plants required, relevant communications and a list of references.

51033 **(ETSU-WV—1589-Pt.1) Wave energy programme feasibility study on a submerged resonant duct. Study report 1st April to 30th June 1979.** (UKAEA Harwell Lab. Energy Technology Div.; Vickers Ltd., Eastleigh (UK). Design and Projects Div.). 1987. 58p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Includes supplement of model drawings and designs.

The first tests with the stage 6 model carried out in the Lancaster Large tank included:- power extraction, air volume, depth of immersion, wave height, repeatability, overtopping tests, efficiency and inward and outward taper. Wavepower structure was investigated. Cost analysis, loading figures, results of experimental work, model drawings and design are discussed.

51034 **(ETSU-WV—1602-Pt.1) Study of wave spectra transformation.** (UKAEA Harwell Lab. Energy Technology Div.; Hydraulics Research Station, Wallingford (UK)). Jun 1982. 29p. (HR-EX—1063). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This study seeks to explain observed changes in wave spectra as the waves propagate from deep water towards a coast. Recorded wave data from two sites off the coast of the British Isles were analysed. A mathematical model of wave refraction and shoaling was set up for both sites and tested at one of the sites using synthesised data obtained from IOS Taunton. An attempt is made to use a model which includes sea bed friction and wave breaking at the site where these seem important. The two areas considered are one off South Uist in the Outer Hebrides and the other off Perranporth in Cornwall. At both of these sites, a pair of waverider buoys have recorded wave conditions simultaneously for several months, with one buoy in substantially deeper water than its companion.

51035 **(ETSU-WV—1623-Pt.1) Development and testing of a 1/10 scale self-rectifying air turbine power conversion system. For period December 1979 to February 1981.** White, P.R.S. (UKAEA Harwell Lab. Energy Technology Div.; Sea Energy Associates Ltd., Feltham (UK); Lanchester Polytechnic, Coventry (UK)). Aug 1981. 70p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

In December 1979 the SEA-Lanchester Wave Energy Group started a programme of theoretical and experimental work to investigate the performance of a self-rectifying air turbine based on the idea first proposed by Dr. A.A. Wells. The work was initiated to provide the project team with accurate design data for the power take off in order that the complete system performance could be analysed. It was felt necessary to provide this data in house, as at that time no results were available from the other groups working with self rectifying air turbines. The result of the work described in the report is that a self rectifying turbine of the Wells type provides a very efficient, elegant, simple and therefore reliable, solution to the power take off aspect of the CLAM Wave Energy Converter.

51036 **(ETSU-WV—1638-Pt.5) Submerged oscillating water column wave energy converters. Study report 1st May 1981 to 1st January 1983.** (UKAEA Harwell Lab. Energy Technology Div.; Vickers Ltd., Eastleigh (UK). Design and Projects Div.). Apr 1983. 94p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

A feasibility study is reported on two configurations of the wave energy conversion device known as the submerged oscillating water column. Extensive wave tank tests of the two models are reported and yield information on the effects of device geometry, damping, manifolding, rectification, water column losses and scale. Costs for a 2 GW scheme indicate unit costs of power of around 4p/Kwh. Recommendations for further work are given.

51037 **(ETSU-WV—1646) Materials for air turbines in wave power devices. A generic study.** Wade, E.H.R. (Y-ARD Ltd., Glasgow (UK)). (UKAEA Harwell Lab. Energy Technology Div.; Y-ARD Ltd., Glasgow (UK)). 1981. 122p. (YR—2694/81; WESC—81-GT-158). British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Wave energy device teams have identified three varieties of air turbine as potentially applicable to wave energy devices. These are: conventional axial turbines; Wells, or self-rectifying, axial turbines and Francis turbines. This report examines the constructional requirements of these devices with regard to mechanical, environmental and manufacturing considerations. It is concluded that the major benefit of optimum material selection will be reduced manufacturing costs rather than enhanced turbine performance. A methodology of material selection has been established and candidate materials have been listed for the major components of each turbine type. Comparative costs for alternative materials are included, from which significant, potential economies have been identified. Recommendations are made aimed at achieving optimum material usage in the proposed turbines.

51038 **(ETSU-WV—1649-Pt.2) Operation, control and monitoring of a 2 GW wave energy scheme.** Buchanan, G.; Jordan, J.R.; Whittington, H.W. (Wolfson Microelectronics Inst., Edinburgh (GB)). (UKAEA Harwell Lab. Energy Technology Div.). May 1982. 150p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The economic viability of wave energy is particularly dependent upon its availability; control and maintenance strategies are important factors in ensuring high availability. The report discusses at length the general requirements for computerized control and monitoring systems for wave energy converters from which details can be extracted to match the requirements of specific options. A final chapter outlines, as an illustration, a specific design for the floating oscillating water column.

51039 **(ETSU-WV—1668-Pt.1) Bending moments in long spines [Edinburgh Wave Power Project]. A report to the Wave Energy Steering Committee.** (UKAEA Harwell Lab. Energy Technology Div.; Edinburgh Univ. (UK)). 1984. 230p. British Library Document Supply Centre, Boston Spa. Wetherby, West Yorks. LS23 7BQ.

A progress report is given on the research programme with the wave energy conversion device known as the Edinburgh Duck. In particular the problem of bending moments in long spines is investigated using a wave tank capable of generating a variety of sea conditions. In parallel with the experimental programme a computer simulation study has been performed and results between theory and experiment are good.

51040 **(ETSU-WV—15067-P1) Study of electrical power transmission from wave energy converters to shore.** (UKAEA Harwell Lab. Energy Technology Div.; GEC Power Engineering Ltd., Stafford (UK). Power Transmission Div.). Oct 1979. vp. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

TAG6 Committee Stage II.

The report describes one proposed scheme for the electrical transmission of power from Wave Energy Converters (WEC's) at sea to a receiving busbar in the Grid system. based on the use of conventional electrical generators on the device at sea with diode rectifiers and high-voltage d.c. transmission to a receiving inverter station on shore. The example assumed is for transmission of 2GW from WEC's mounted off the Hebrides, to receiving busbars near Perth in Scotland. The scheme is applicable to all of the various WEC types which have been proposed, including the Salter Duck, Cockerell Raft, Oscillating Water Column and others. The report is confined to the electrical system, and excludes the method of mechanical drive to the electrical generators. The transmission scheme is concluded to be technically feasible without extensive engineering development. The report includes cost estimates for the electrical equipment; excluding generators, cables, lines and civil works this is Pound 124M for 2GW, or Pound 62/Kw of peak rated power.

51041 **(JFS—8601) Feasibility study on conversion from natural energy of waves to mechanical energy.** (Japan Foundation for Shipbuilding Advancement, Tokyo). Mar 1986. 116p. (In Japanese). NTIS (US Sales Only), PC A06. Order Number DE88752066/JAW.

This is a report of 1985 of Institute of Ocean Environmental Technology on the projected research and of the yearly result of 6 years of research. Evaluation of the floating type wave power generation plant was started since 1984 has been continued, and, in parallel, a remote automatic control unit was manufactured and installed as well as the power transmission cable, and finally the comprehensive evaluation test was carried out. All equipments smoothly operated including the accumulation of an incident wave power; amount of power output at the output terminal was roughly 9.5 KWH for 29.7 KWH of average incident wave power. The conversion efficiency at the final power reception terminal (after going through the commercial storage battery and DC/AC inverter) was 0.13; this indicates the conversion efficiency of 60 - 30 % if considering the direct utilization of the accumulated oil pressure or the utilization at the power generating end. (79 figs, 19 tabs, 48 refs)

17 WIND ENERGY

51042 **(STEV—1988-R2) IEA R and D Wind Energy. Annual report 1987.** (Statens Energiverk, Stockholm (Sweden)). Dec 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754445/JAW.

The IEA R and D WECS programme comprises nine Tasks, six of which have been successfully completed. Current Tasks include Study of Offshore Wind Energy Conversion, Study of Decentralised Applications for Wind Energy, and Intensified Study of Wake Effects. Substantial progress is reported from the ongoing Tasks. A programme of further work on offshore wind energy is recommended, including a plan for an offshore prototype. Decentralised Applications for Wind Energy has two Subtasks on Site Assessment Techniques to define models and techniques for obtaining wind and load data for decentralised wind systems, and on Wind Diesel Systems for analysing the performance of these systems. Intensified Study of Wind Turbine Wake Effects includes wake measurements from windfarms and single turbines as well as theoretical model studies.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 50944

51043 **(ECN—88-040) Reliability of wind speed measurements.** Van der Borg, N.J.; Curvers, A.P.; Schuurman, J.J.; Stam, W.J.; Vink, P.W. (Netherlands Energy Research Foundation, Petten). Feb 1988. 8p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

At measuring wind speeds for the purpose of investigating wind turbines, a number of possible error resources can be indicated, which influence the reliability of the measurement results. Some of the error resources are important for measuring the wind speed near the anemometer, and some are important in connection with

the representativity of the measured wind speed for the undisturbed wind speed near the turbine rotor. The properties of the anemometer (calibration, dynamic behavior, wear out, pollution) and the electronic measurement circuit from the anemometer signal to the data acquisition fall into the first category. Field influences are very important in the second category. In general there are stochastic as well as systematic differences between the measured wind speed and the requested undisturbed wind speed. A review is given of the procedure used by Netherlands Energy Research Foundation (ECN) to limit the influence of possible error resources to a minimum. Also experiences are discussed gained with the behavior of cup-anemometers during a certain time and gained with calibration in different wind tunnels. 9 refs., 2 tabs.

1703 Regulations

51044 **(ECN—88-053) Certification of wind turbines.** Stam, W.J. (Netherlands Energy Research Foundation, Petten). Mar 1988. 8p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

Operators of wind turbines in the Netherlands can qualify for an investment subsidy. One of the conditions is a so-called 'Beperkt kwaliteitscertificaat' (Restricted quality certificate or BKC). The BKC is issued by ECN (Netherlands Energy Research Foundation) only after a thorough practical and theoretical test. There is a clear interaction between the evaluation of the design and the practical testing. On the one hand bottlenecks in the evaluation of the design can be solved by measurements, on the other hand the results of the measurements sometimes lead to adaptations of the basic design. The ECN-certificates are demanded more often by buyers, licensors and probably also by insurance companies. There is a growing interest in the certificates outside the Netherlands, in particular in Germany and Belgium. 3 refs., 2 tabs.

51045 **(ECN—88-060) NEN 6096, the standard for small horizontal axis wind turbines.** Machielse, L.A.; Ottens, H.H. (Netherlands Energy Research Foundation, Petten). Feb 1988. 10p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

In this report the altered design of chapter five in the Dutch standard NEN-6096 is discussed. This standard is entitled 'Safety provisions for wind turbines' and was published in 1985. Chapter five, about constructional safety, has been criticized. Therefore it has been altered using the results of the project 'Design criteria for small wind turbines', which project was finished in 1987. Furthermore the procedures and terminology in the new TGB (Technical Fundamentals for Structures, NEN-6700 and more) were used. 2 refs., 4 tabs.

51046 **(ECN—88-080) Recent developments in the Dutch safety regulations for WECS.** Machielse, L.A.; Ottens, H.H. (Netherlands Energy Research Foundation, Petten). Mar 1988. 12p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the Workshop on wind energy and the environment, London, UK, 21-22 March 1988.

Chapter 5 of the Dutch standard NEN 6096, dealing with structural safety has been rewritten lately. The revised version of the standard will be published in summer 1988. The new safety regulations offer the designer the opportunity of a less conservative and more detailed determination of design loads, especially for fatigue calculations. The definition of safety margins has an explicit form using material and load factors. The method and terminology are in agreement with coming codes for buildings that will become widely known among local authorities. 4 refs., 6 tabs.

51047 **(ECN—88-081) Recommendation for a European wind turbine standard on performance determination. 1. Comparison of existing standards. Interim report.** Curvers, A.P. (Netherlands Energy Research Foundation, Petten). May 1988. 26p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Commission of the European Communities has commissioned a contract to the Netherlands Energy Research Foundation (ECN) to conduct a study on the subject of 'European Wind Turbine Standard on Performance Determination'. Up to now three different organizations have compiled recommendations with respect to the measurement of the wind turbine performance characteristic: 1. International Energy Agency (IEA); 2. American Wind Energy Association (AWEA); and 3. Canadian Standards Association (CSA). A comparison on main points of the recommendations, published by these three organizations, to draw up an inventory has been carried out and leads to some general conclusions. Next to these three standards a second source of information is used to state a European standard. That is the EC study 'Accuracy of power curve measurements', (report Risoe-M-2632, Nov. 1986). Recommendations, as mentioned in the report, with respect to the European Wind Turbine Standard on performance determination, are summarized.

1704 Economics

51048 **(ECN—88-013) Measurements on the simulation arrangement for an autonomous wind-diesel system. Part 3: Diesel start/stop operation for short term energy storage, dimensioning or up-scaling of the different components.** Klerks, W.M. (Netherlands Energy Research Foundation, Petten). Jan 1988. 33p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Making use of the appropriate verification arrangement of an autonomous wind-diesel system (AWDS), executed with the help of a wind turbine simulator, a link was made between variables and dependencies. Also this offers the possibility for mutual comparison of AWDS's in general as well as relative norms for up-scaling. The purpose of the measurements is to be able to correlate the relation between wind power and consumer capacity on the one hand and the dependent variables like diesel operation time, number of starts and fuel consumption per unit of time on the other hand with the storage capacity as parameter. The AWDS is a diesel generator with a simulated wind turbine. They can feed the autonomous net apart or in combination. From the conclusions it appears that by making use of a certain ratio variables in an AWDS can be correlated in a useful way. An AWDS with short term storage and diesel start/stop operation can yield considerable extra fuel savings compared to diesel systems with continuing operation. As the case may be the extra savings can be 40% of the fuel consumption for 'diesel apart'. 1 app., 7 figs., 7 refs., 3 tabs.

51049 **(ECN—88-046) The power production of wind turbines.** Van der Borg, N.J.; Curvers, A.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Feb 1988. 11p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

The efficiency of wind turbines is determined by the annual energy production, next to investment costs and costs of maintenance. This energy production depends on the local wind regime, the energetic efficiency, the axis height, the rotor diameter and the availability of the turbine. The potential annual yield of 16 turbines has been determined making use of the capacity curves measured by Netherlands Energy Research Foundation (ECN). The assumptions made are: the availability of the turbine is 100%; the annual average wind speed on rotor position is 6 m/s; the frequency partition of the wind speed on rotor position meets a Weibull partition with a form factor of 1.95. The potential annual yields are characterized by means of the yield factor. This quantity is equal to the potential annual yield (in kWh) divided by the annual average wind speed (in m/s) raised to the third power and divided by the rotor surface (in m/sup 2/). From the results it appears that there has been a clear increase of the power production of the Dutch wind turbines in the last two years. Also the yield factors of 5 Danish turbines are determined, making use of the measured capacity curves as to be found in the literature. Some quantities, which influence the potential annual yield, like the number of revolutions of the rotor, rotor geometry and transmission efficiency, are, when possible, illustrated on the basis of practical data. 8 figs., 23 refs., 2 tabs.

1705 Environmental Aspects

51050 (ECN—88-039) The acoustical source intensity of wind turbines. Van der Borg, N.J.; Stam, W.J.; De Wolf, W.B. (Netherlands Energy Research Foundation, Petten). Feb 1988. 8p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

Noise pollution can be a restricting factor for the application of wind turbines. To gain insight into the quantity and source of the noise production of wind turbines the acoustical source intensity of 35 different turbines was determined. The source intensities of 17 turbines was gained by own measurements. The source intensities of the other turbines were deducted from published and not published measurement results of other researchers. An empirical relation was determined for the source intensity, the rotor diameter and the tipvane velocity of the present generation of wind turbines, making use of the 35 measured source intensities and corresponding data. Besides it was tried to investigate the influence of the tipvane velocity on the source intensity by making use of the source intensities of three wind turbines, which were measured for different rotor revolutions. In general the noise production of wind turbines is mechanically and aerodynamically originated. A semi empirical forecasting model for the aerodynamic source intensity of wind turbines is presented. The so predicted aerodynamic source intensities are compared to the measured total source intensities. Assuming that the model is correct, then the decrease in noise production for small wind turbines (maximum 20 m diameter) can be realized by tackling the mechanical noise. For large turbines decrease in noise production can be realized by tackling the aerodynamical noise. 2 figs., 35 refs., 2 tabs.

51051 (TNO-TPD—607.030/1) Acoustic research on two nacelle models of wind turbines. Phase 1: Preliminary study. Van Schie, L.W. (Nijverheidsorganisatie TNO, Delft (Netherlands). Technisch Physische Dienst). Jan 1987. 20p. (In Dutch). Technisch Physische Dienst TNO-TH, P.O. Box 155, 2600 AD Delft, Netherlands.

Under the authority of the Project Control Agency for Energy Research (PEO) the Technical Physical Service (TNO-TH, Delft, Netherlands) executed the first part of the project 'Scale model research on two nacelle designs for noiseless wind turbines'. This preliminary study led to a few design drafts and a review of output data with the help of which a manufacturer can formulate a tender. This report accounts for the considerations which played a part in making the design drafts. The aim of the project is a quantitative determination of the effect of measures to reduce noise of two strongly different nacelle designs. The research will be done on two scale models of 300 kW turbines. In one model the nacelle wall has a basic strength function, in the other model the wall serves as a screen (function integration versus function separation). For both models the different sound transmission paths will be quantified for a number of variants. To be expected the results will enable the industries involved to pursue an offensive strategy with regard to the sound aspect. 3 app.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 51044, 51045, 51046, 51047, 51051, 51070, 51437

51052 (DOE/NASA/20320—74) Testing of a one-bladed 30-meter-diameter rotor on the DOE/NASA Mod-0 wind turbine. Ensworth, C.B.F. III; Corrigan, R.D.; Berkowitz, B.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Sverdrup Technology, Inc., Cleveland, OH (USA)). Mar 1988. Contract AI01-76ET20320. 12p. (NASA-TM—100274). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015114/JAW.

As part of the Federal Wind Energy Program of the Department of Energy, NASA Lewis Research Center conducted tests on the DOE/NASA Mod-O horizontal-axis wind turbine with a one-bladed rotor configuration. The single blade had an overall length of 15.2 m, and used a pitchable tip that spanned 12 percent of the blade radius. The blade was balanced by a counterweight assembly that consisted of a solid steel ellipsoid supported at an outer radius of 4.6 m by a steel spar. The blade and counterweight assembly were mounted to a teetered hub in a downwind configuration. The objectives of these tests were to obtain data on the performance, loads, and dynamic characteristics of an intermediate-size, one-bladed rotor. These data, measured at a nominal rotor speed of 49 rpm, were compared with corresponding data for a two-bladed rotor at 33 rpm, having the same blade length and airfoil characteristics. The two-bladed rotor was previously operated on the same machine. The one-bladed and two-bladed rotors used common components wherever possible and did not represent optimized rotor designs. The results of the one-bladed rotor tests showed that this configuration can be operated successfully. There were no significant dynamic loads with this configuration, and the fatigue loads were comparable to those of a two-bladed rotor. A decrease in power output equivalent to a reduction in wind-speed by 1 m/sec occurred with the one-bladed rotor when compared with the aerodynamically similar two-bladed rotor operating at two-thirds of the rotor speed. Analytical methods for predicting the performance and dynamic characteristics of a one-bladed rotor were verified. 2 refs., 8 figs., 1 tab.

51053 (ECN—87-052) Measurements on the simulation arrangement for an autonomous wind-diesel system. Part 2: Influence of system losses and application of the flywheel on the gust-free capacity. Klerks, W.M. (Netherlands Energy Research Foundation, Petten). Mar 1987. 38p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Losses originate when wind power is converted to electric power. In particular in autonomous wind-diesel systems (AWDS), aimed at maximal fuel savings, the gust-free wind power determines the possibility to stop or start the diesel engine. The AWDS is a diesel generator and a simulated wind turbine with an asynchronous generator. It is important to know the above-mentioned losses because the gust-free wind power is only about 20% of the average wind power. The losses have to come out of these 20%. For this system the total and specified losses are measured as a function of the consumption load (kW) and the net frequency (50 Hz and 59 Hz) as parameter. Then the results of the measurements are given from which it appears that the simulator simulates a theoretical wind turbine rotor plus gear drive in the right way. Next the results of measurements are given of different loads with and without flywheel in the system and real wind (time 1 h) as input in the simulator. Also the gust-free consumption capacity for this wind supply is determined for situations with and without flywheel. 14 figs., 2 refs., 5 tabs.

51054 (ECN—88-036) Comparison of blade materials for a small stall controlled turbine. Machielse, L.A. (Netherlands Energy Research Foundation, Petten). Feb 1988. 9p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

This report surveys the possibilities and restrictions of different construction materials for the purpose of the blades of a small stall regulated turbine. For example scaling up, material saving at decreasing of static or dynamic loads, comparisons of global costs based on prices per unit of weight, etc. For the mutual comparison of construction materials for turbine blades the starting point is a stall regulated horizontal axis turbine with a rotor diameter of 16 m and a tipvane speed of about 64 m/s. Short descriptions are given of the materials and of the applied production methods with the resulting blade geometry. The blade skins are dimensionized for storm loads after the optimalization of the blade geometry, needed for the design wind speed, is recorded. The resulting blade skins are mutually compared as for weight, mass inertia and bending stiffness. Also a comparison took place of the resulting reserve factors against load variations caused by gusts of wind and own weight, and of the bending of the tip caused by storm load. The conclusions direct in particular to comparisons of the metal blades (steel, aluminium) and the non metal blades (wood-epoxy, fiberglass reinforced polyester, aramid fibers with epoxy resin). 3 figs., 5 refs., 3 tabs.

51055 **(ECN—88-041) Wind structure and rotor loads.** Dragt, J.B. (Netherlands Energy Research Foundation, Petten). Feb 1988. 9p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

This presentation discusses especially those aspects of the wind structure which are responsible for fatigue loads on the rotor. Characteristics of that structure are dealt with. Little is known of it in the wake of other wind turbines. The nature of the loads resulting from turbulence is discussed: a quasi-periodical signal, of which form and height change gradually every revolution. Existing turbulence formalizations for design calculations are elucidated. The relative importance of the effect of turbulence 'transection' is given for large and flexible rotors. Finally a review is given of methods to calculate loads from turbulency: deterministic formalization, stochastic simulation or statistic modelling. 6 figs., 13 refs.

51056 **(ECN—88-043) Measurements of mechanical loads on the NEWECS 45, Wieringermeer. Experiences and results.** Dekker, J.W.; De Groot, C.M.; Hensing, P.C. (Netherlands Energy Research Foundation, Petten). Feb 1988. 11p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

In the period January 1, 1986-December 31, 1987, a measurement program on the NEWECS 45 wind turbine was executed. Part of this program concerned measurements of mechanical loads and energy yield, of which the results are discussed. The measurements can be classified as follows: continuous measurements of wind speed and generator capacity as 10 min averages; long duration measurements for determination of the average mechanical loads as a function of the wind speed (sampling frequency 1 Hz); short duration measurements of the fluctuating mechanical loads (sampling frequency 32 Hz). The average measured mechanical loads are tested to the design calculations. The analogy between calculations and measurements is satisfactory. The fluctuation of the loads was measured too and the results recorded in a so-called rain flow matrix, and intensifies as function of the frequency. During the design an aero-flexible stability calculation was executed. A calculation method for the intensities of the spectral components of the mechanical loads is not yet operational as a design tool. The development and verification of such a design tool is essential to the design of a large wind turbine with a long life and a high availability. 10 figs., 16 refs., 7 tabs.

51057 **(ECN—88-044) Dynamic regulation of the blade-angle for the test facility 25 m HAWT.** Van Engelen, T.G.; Kock, Z.G.; Lekkerkerk, F. (Netherlands Energy Research Foundation, Petten). Feb 1988. 8p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

On the basis of theoretical knowledge of a model a scalar capacity regulator with proportional and integrated action has been designed for the test facility 25 m HAWT. The 25 m HAWT is a wind turbine with a rotor diameter of 25 m, with a direct-current generator and a nominal capacity of 300 kW. The theoretical model is implemented on a PDP 11/24 computer in Fortran 77 and consists of a few connected algebraical relations and differential equations. The regulator adjusts automatically through a table function and a sliding average of the blade-angle. The operation of the regulator is compared to an existing capacity bounder in simulation. The new regulator shows a better behavior. An experiment in full load with a number of regulator adjustments is executed. The acceptable reinforcement of the regulator appeared to be lower than expected on the basis of simulation. This is caused by non-linearities, which result in an amplitude dependable disturbance- and adjustment behavior, and deficiencies of the model (hydraulic adjustment system, aerodynamic transmission). 7 figs., 7 refs., 4 tabs.

51058 **(ECN—88-048) Fatigue investigation of wind turbine materials.** Bach, P.W. (Netherlands Energy Research Foundation, Petten). Mar 1988. 10p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

Investigation of the fatigue resistance of materials and compound types for wind turbine blades executed by the Netherlands Energy Research Foundation (ECN), National Aerospace Laboratory (Netherlands) and some industrial partners. The investigation concerns: glass fibre strengthened polyester (GSP) plates; mortise and tenon joints; glued connections of GSP plates and steel flanges; welding joints of St 37 plates of different gauges. It appears from the constant amplitude tests of the GSP plates that there is probably a fatigue limit at a low load and at a great number of load variations (> 10/sup 9/). The results have been analyzed statistically, so that chances of failure can be deducted. The fatigue research on the composites is still going on, so that only intermediate results are reported. From a preparatory investigation, by which a few variants of these composites were tested, it appeared, among other things, that about 50% diagonal fibre strengthening is needed for mortise and tenon joints. Also it appears that there is extension of life if this connection is put under prestress. A gradual edging of the steel flange was needed for the glued connections to decrease the peak tension. The primer layer on the steel led to premature failure. Improvements have been introduced for the following up program. 6 figs., 7 refs.

51059 **(ECN—88-061) From loads to determination of lifetime. An overview.** Foellings, F.J.; Machielse, L.A. (Netherlands Energy Research Foundation, Petten). Feb 1988. 10p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

The estimation of the lifetime of the different components is an important part of the detailed design of a wind turbine. This overview outlines the ways in which the lifetime of a detailed construction is estimated. In particular the stress in the calculation procedure, in which the biggest uncertainties or inaccuracies occur, are discussed explicit. The most important variable loads come up: the calculation of the resulting material stress and the counting of the number of load variations. Fatigue data of different kinds of material and combinations are dealed with as well as the damage rule with which lifetime can be estimated. Finally attention will be paid to the subject of testing. 4 figs., 25 refs., 1 app.

51060 **(ECN—88-063) Statistical processing of data on wind.** Lekkerkerk, F. (Netherlands Energy Research Foundation, Petten). Mar 1988. 14p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the 4. National conference on wind power, Noordwijkerhout, Netherlands, 22-24 February 1988.

For the design and location of wind turbines it is important to have proper descriptions of wind characteristics. A project is planned by the Netherlands Energy Research Foundation (ECN) and the Dutch organization for Applied Scientific Research, Social Technology (TNO-MT) to determine parameters of possible gusts of wind. Ten minutes measurements on wind are executed in Petten, Netherlands. Different processing programs have been developed and used to calculate and analyse the data. The collected data indicate the amplitude, the strongness and the duration of gusts depending on the weather conditions. To estimate the form of a gust exactly additional information is needed. In the future research is needed on defining fatigue gusts and giving a more compact representation of the results from wind measurements. Besides the results of the measurements should be applicated to dynamic load fluctuations of a turbine rotor in a turbulent wind field. 12 figs., 3 refs.

51061 **(ECN—88-065) Measurements of mechanical loads on the NEWECS-45, Wieringermeer, the Netherlands.** Dekker, J.W. (Netherlands Energy Research Foundation, Petten). Mar 1988. 27p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the IEA fatigue workshop, Harwell, UK, 21-22 March 1988.

At the 1 MW NEWECS-45 wind turbine, Wieringermeer, the Netherlands, a measurement program of mechanical loads has been completed. The averaged measured mechanical loads were compared with design calculations. The agreement between calculation and measurements is sufficient. The fluctuating part of the

loads has been measured and reduced to rainflow-counting matrices as well as intensity spectra as a function of frequency. In the predesign fase aero-elastic stability calculations were made. Unfortunately, the results of these calculations cannot be compared in a meaningful way with measured results, because of the fact that later on changes in the design were made. At the moment calculational methods for the intensities of spectral components are not yet fully operational. Further development of these design tools is indispensable for the design of a large wind turbine with a long life and a high availability. 10 figs., 16 refs., 7 tabs.

51062 **(ECN—88-088) Recent results of the wind diesel project of ECN.** De Bonte, J.A.; Klerks, W.M.; Kraayvanger, A.W. (Netherlands Energy Research Foundation, Petten). May 1988. 19p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Research of the Netherlands Energy Research Foundation (ECN) into autonomous wind diesel systems (AWDS) has resulted in two new developments which have been tested at experimental facilities, and which are now ready for a commercial follow-up: design rules and criteria for an optimal incorporation of a flywheel in an AWDS, and for dimensional optimization of the main components of a flywheel-incorporated AWDS, have been established and tested; the dump load with its control unit in an AWDS test rig, has been successfully replaced by a far more economical control of the electric conversion system of the variable speed wind turbine (excitation control). Also, experiments are being carried out concerning the incorporation of an accumulator (battery bank, 400 V, 50 kWh) into the DC-link of the conversion system of a variable speed wind turbine. 7 figs., 6 refs., 1 tab.

51063 (KIRI—8601, pp 5-6) **Experimental manufacture of device collecting data concerning wind direction, wind velocity, and power output using one board microcomputor.** Yasuda, Makoto; Katsumata, Taketoshi; Moriyama, Yoshiki. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). 15 Oct 1986. (In Japanese). Industrial Research Inst. of Kanagawa Prefecture, 3173, Showamachi, Kanazawaku, Yokohama, Japan.

In Materials of Research Results in Fiscal Year 1986.

In order to learn performance of a wind power generation apparatus, a data collecting device using a microcomputer was manufactured experimentally and automatic data collection was tried. As the results, the following knowledge was obtained: 1) Since hourly data are successively stored in a 2K bite memory, a long term data collection can easily be done by connecting the memory to the microcomputer about once a week for transmission and storage, Furthermore, by utilizing a personal computer, etc. storage and processing of a large amount of data become easier. 2) By utilizing optical fiber, remote control of an observation and collection device becomes possible. 3) As the problems hereafter, it is necessary to establish the measures to suppress noises well and in addition, to examine such system improvement measures as the utilization of real time clock, etc.. (3 figs)

51064 (KIRI—8601, pp 3-4) **Study of variable pitch vertical shaft windmill.** Katsumata, Taketoshi; Moriyama, Yoshiki; Kazama, Haruo; Yasuda, Makoto. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). 15 Oct 1986. (In Japanese). Industrial Research Inst. of Kanagawa Prefecture, 3173, Showamachi, Kanazawaku, Yokohama, Japan.

In Materials of Research Results in Fiscal Year 1986.

Concerning vertical shaft windmills, there are Savonius type, Darrieus type, and Gyromill type and their features are 1) being non-directional irrespective of the wind direction, 2) receiving no gyroscopic load, and 3) being possible to install its power shifting device on the ground level. Against the above, their shortcomings are as follows: 1) Dynamic lift type windmills have very poor self-starting capabilities. 2) Mechanical strength design of the blade support is difficult. 3) Their operation records are not many. Because of the above, a pitch control mechanism by means of a link and a pitch control rudder was studied in order to improve its self-starting capability and the following information was obtained: 1) In case of the pitch eccentricity of 70mm, the mill starts at the wind velocity of about 3m/s, showing the good self-starting characteristic, but revolution hits the ceiling due to large pitch angle. At the pitch eccentricity of 50mm, revolution goes up almost linearly. 2) Torque character value becomes larger as pitch angle becomes larger. (6 figs)

51065 **(ME—NRCC24666) An analysis of cycle charge and wind turbine hybrid power plants for remote community applications.** (Mechron Energy Ltd., Ottawa, Ontario (Canada)). Mar 1985. 156p. (CE—01879). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Cycle Charge 4000 is a diesel power system designed for small remote applications. Intermittent diesel operation while charging batteries permits a high load factor. Batteries further permit an efficient interface for wind energy conversion systems (WECS). This study compares the economic and technical performance of Cycle Charge and Cycle Charge/WECS hybrid systems with conventional diesel power operation in a typical (50 kW peak) remote community. Load characteristics are assumed to be ca 233 MWh/y at a 53% load factor. Historical wind data from a Newfoundland site are used to give an average yearly wind regime of 6.4 m/s. Yearly system operation is computer simulated to obtain battery, diesel engine and WECS performance characteristics. Diesel capacity is held constant at 100 kW while 3 battery sizes and 3 WECS sizes are simulated in 12 configurations. 20-year life cycle costs are compared at a 7% discount rate for delivered diesel fuel prices of $0.30 to $1.50/l. Results indicate positive net benefits for all alternatives, which are highly sensitive to fuel price and WECS capacity but relatively insensitive to battery size. Cycle Charge systems exhibit 5-10% benefits at fuel prices above $0.30 that rise linearly to almost 20% benefits at prices of $1.50/l. Cycle Charge/WECS systems exhibit small to slightly negative benefits at low fuel prices. The largest WECS performs best with increasing fuel prices rising almost linearly to 45% benefits at costs of $1.50/l. Further benefits are likely to be obtained with larger WECS and possibly larger battery capacities. 22 refs., 20 figs., 25 tabs.

51066 **(NLR-TR—86112-U) Design criteria for small wind turbines. Part 1: Survey.** Van der Linden, H.H. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). Oct 1986. 100p. (In Dutch). National Aerospace Lab. NLR, P.O. Box 90502, 1006 BM Amsterdam, Netherlands.

As part of the project 'Design criteria for small wind turbines' research is done on possible refinements of the loads described in the standard Design NEN-6096, concentrated on small wind turbines. Small wind turbines were classified into 6 categories in order to be able to value different designs of wind turbines with regard to the load. The classification is based on differences in control- and electro-magnetic conversion systems. Fatigue gusts and blasts have been determined with the help of a model using statistical methods. Also turbulent wind-direction fluctuations and the difference in wind speed between upper- and lower-side of the rotor have been determinated. The examined loads are described for normal operation and normal parking. The fatigue load is elaborated on the basis of response calculations. The extreme rotor load for each of the wind turbine categories was worked out for both abnormal extern and abnormal internal circumstances. The results were presented partly as graphics, partly in formulas. A procedure is given to estimate inherent frequency. Then a comparison is made between the developed design loads and the loads from the standard Design NEN-6096. Finally recommendations are made for further research with some concluding remarks. 2 app., 30 figs., 31 tabs.

51067 **(PB—88-219035/XAB) Improved and new water-pumping windmills.** McKenzie, D.W. (Forest Service, San Dimas, CA (USA). Equipment Development Center). 1984. 17p. NTIS, PC A03/MF A01.

The conventional multibladed windmill - a functional, reliable, long-lasting, economical-range water-pumping system - has been in use for over 125 years. However, work continues on improvements to the conventional windmill and the development of new designs such as: Fully counterbalanced windmill; Spring-counterbalanced windmill; Cam-operated windmill; Hydraulic system

which replaces the pump rods of a conventional windmill; Automatic stroke control for a conventional windmill; Automatic stroke control for a three-bladed wind turbine; Electric wind ac generator driving an ac submersible pump; Electric wind dc generator driving a dc submersible pump; Windmill-driven air compressor operating an air-lift pump; Long-life well cylinder; Performance modeling and testing of windmills.

51068 **(SERI/TP—217-3334) Peak power and blade loads on stall-regulated rotors as influenced by different airfoil families.** Tangler, J.L.; Tu, P.K.C. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1988. Contract AC02-83CH10093. 9p. (CONF-8806205—1). NTIS, PC A02. Order Number DE88001190/JAW.

From AWEA/RETSIE symposium; Santa Clara, CA, USA (7 Jun 1988).

At the Solar Energy Research Institute (SERI), new airfoils have been developed to help improve the performance and economics of horizontal-axis wind turbines (HAWTS). The objective of this study was to compare the performance characteristics of one of these airfoil families to other commonly used airfoil series for a typical three-bladed, stall-regulated HAWT. The traditional airfoil series chosen for comparison with SERI's new thin airfoil family were the NACA 23XXX, NACA 44XX, and NASA LS(1). The Micon 110 wind turbine was chosen because it is a typical three-bladed, stall-regulated rigid rotor system. The performance characteristics of the different airfoil series were derived analytically using the Eppler airfoil design code in the analysis mode. On a relative basis, this approach to comparing airfoils was considered more accurate than using airfoil performance characteristics based on wind-tunnel test data. After generating the performance characteristics for each airfoil series, the subsequent rotor performance and blade loads were calculated using SERI's PROPSH computer code. Resulting annual energy output, which is dependent on the wind-speed distribution, was calculated using SERI's Systems Engineering and Analysis Computer Code (SEACC). The results of the study show that fixed-wing airfoils generally result in excessive peak power for stall regulated, rigid rotors. By operating the wind turbine at a less desirable blade pitch angle, peak power can be reduced at the expense of higher mean blade loads and lower annual energy output. In contrast, the thin airfoil family was designed to reduce peak power at optimum blade pitch to minimize blade loads and maximize annual energy output. 7 refs., 12 figs.

51069 **Harmonics generated by two variable speed wind generating systems.** Herrera, J.I.; Reddoch, T.W.; Lawler, J.S. (Electrotek Concepts, Inc., Knoxville, TN (US)). *IEEE Transactions on Energy Conversion;* 3: No. 2, 267-273(Jun 1988).

Two variable-speed, constant-frequency generating systems are tested on the MOD-0 experimental wind turbine in order to quantify the harmonic currents and voltages at the connecting point to the utility system. The total harmonic current and voltage distortions are calculated and compared to those calculated for an induction generator which is taken as the base system.

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51070 **(FRNC-CONF—267) Technical and economical feasability of small scale systems using renewable energy in developing countries.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 122p. (In French). (CONF-8605345—). NTIS (US Sales Only), PC A06/MF A01; GPO Dep. Order Number DE88754040/JAW.

From Seminar on technical and economical feasability of small scale systems using renewable energy in developing countries; Sophia-Antipolis, France (31 May 1986).

The various rural electrification schemes in remote zones of developing countries are reviewed and analysed: technical state of the art, specific constraints, costs, large scale development possibilities, advantages and drawbacks. The following schemes are described: interconnected network extension to rural zones, local electricity production through internal combustion motors, micro-scale hydroelectric power plants, photovoltaic power plants, wind turbines, electricity from biomass conversion. Other schemes of renewable energy utilization are also reviewed: water pumping, lighting, refrigeration, telecommunications, etc.

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REFER ALSO TO CITATION(S) 50344, 50345, 50346, 50347, 50348, 50349, 50350, 50351, 50352, 50352, 50354, 50356, 50356, 50501, 50501, 50502, 50502, 50503, 50590, 50590, 50591, 50591, 50702, 50931, 51048, 51062, 51062, 51093, 51192, 51281, 51342, 51343, 51427, 51551

51071 **(CRIE—T-86039) Method for dynamic security control of power systems. Fundamental computer program of DSC by sensitivity analysis of eigenvalues.** Uchida, Naoyuki; Takasaki, Masahiro; Yoshimura, Kenji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Feb 1987. 37p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770172/JAW.

Central Electric Power Institute is promoting an integrated automation by the application of advanced information technology including a development of security control on a new concept of automonous distribution control. Especially concerning the stability which easily is a bottle-neck for the system operation, an on-line security control based on high speed stability analysis will enable the effective and continuous system operation and control responding to the ever-changing power distribution conditions maintaining the proper level of reliability and keeping the supply cost at minimum. In this report, by utilizing an eigenvalue sensitivity coefficient, stability margin was obtained and a new theory of attaining the preventive control of stability margin was developed and its effectiveness was confirmed. (16 figs, 8 tabs, 6 refs)

51072 **(CRIE-T—86027) Internal heat exchange tube vibration induced by cross and parallel mixed flow.** Kawamura, Koji. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 27p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770177/JAW.

In order to reduce the plant cost of a pool type LMFBR, technology for more effective design of intermediate heat exchangers is being developed. This time, a zigzag-flow internal heat exchanger which has baffle plates and whose secondary coolant has a cross flow component has been proposed. This exchanger can improve heat transfer performance and make the temperature distribution even, but the heat transfer tube is exposed to a variety of cross and pararrel mixed flow. Also, since a thin heat transfer tube is used for better heat transfer performance, evaluating the soundness of the heat transfer tube against vibration is important. The effect of structural parameters like the baffle plate shape and natural frequencies of tubes as well as flowing condition on the transfer tube vibrations was made clear. Also a systematic technique for evaluating vibrations in cross and parallel mixed folw was developed. This method helps examine structure and flow design of the internal heat exchanger in the light of vibrations. (21 figs, 11 refs)

51073 **(CRIE-U—86044) Development of the techniques for marine macrophyte bed creation in the coastal zone near a power plant.** Kikuchi, Kotaro; Sato, Syusei; Honda, Masaki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 12p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770181/JAW.

Zostera marina, an eelgrass, is considered very important for the protection of marine resources and environment conservation. There are two kinds of Zostera marina: a therophyte which from flowering shoots and leads summer in seeds, and a perennial which grows mainly by dividing its nourishing roots. The difference between the two has been believed to be due to environmental, rather than heredital, factors. This hypothesis was examined experimentally this time using annual seeds of Zostera marina from Yojirogahama Chosuiro at Kagoshima Bay and perennial seeds from Odawa Bay. As a result, the following points were made clear. As to annual one from Kagoshima Bay, its nature of forming flowering shoots is not caused by the environment but has a hereditary characteristic, and the characteristic is immune to environment changes during short time. When creating a marine macrophyte bed in a coastal zone near a power plant, the transplantation of perennial Zostera marina seems to be effective in a place with its environ-

ment resembling to a marine macrophyte bed which has perennial ones. (2 figs, 5 tabs, 2 refs)

51074 **(CRIE-W—87013) Present technology and its themes of insulation diagnosis of large A.C. generator windings.** Ikeda, Yasuyuki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1987. 39p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754541/JAW.

With the object of improving the technique for evaluating the remaining life of mica-resin insulated generator windings, data on non-destructive and destructive insulation testing characteristics were collected, and the present situation of insulation diagnostic technology was exxamined. As the result, it has been clarified that the residual dielectric breakdown voltage Vr of turbine generator windings which underwent remarkable variations in load has greatly decreased with the lapse of time. This suggests the necessity of conducting a periodic insulation diagnosis on generators operating under severe conditions such as DSS (daily start stop) operation. It has also been made clear that the annual decrease ratio A (average) of the Vr of mica-resin insulated windings was 1-3 %, there was no great difference from the A=2.5 % of asphalt-compound insulated windings. New devices for measuring insulation characteristics have been developed and put into practical use by utilizing recent advances in electronics and computor processing technology. For the future, expectations are being placed on shortening the measurement time, improving the accuracy of insulation diagnosis and the safety of measurement, etc. (29 figs, 9 tabs, 26 refs)

51075 **(CTH-IE-A—86-161) Gas turbines for combined power and heat generation. A thermodynamic outline.** Wingaard, S.; Leckner, B. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Energy Conversion). Nov 1986. 49p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754393/JAW.

The most important characteristics of gas turbines for combined heat and power production are illustrated by thermodynamic calculations. The influence of fundamental design parameters like pressure ratio and temperature in turbine inlet are evaluated. Also intercooling, regenerative heating, interburning and afterburning are considered. Interburning turned out to be one of the most favourable alternatives. Assessment of partial load characteristics of different engine types was achieved by adapting the heat power to a simplified energy need diagram. As valuation of electricity in relation to heat plays an important part in the comparison a concept value factor is introduced. (O.S.).

51076 **(DOE/EIA—0509) Estimating the capital costs of life extension for fossil-fuel steam plants.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Aug 1988. 52p. NTIS, PC A04/MF A01 - GPO; 1; GPO Dep. Order Number DE88016487/JAW.

In the past, electric utilities built new plants to meet growth in the demand for electricity or to replace old, inefficient plants. Today, utilities are considering other options for meeting future demand, such as conservation programs, load management, purchase of nonutility generation, bulk power purchases, and repowering and life extension (refurbishment) of existing plants. All of these options will play a role in utilities' efforts to meet the demand for electricity. The purpose of this report is to estimate life-extension capital costs for use by the Energy Information Administration (EIA) in its forecasting models. A methodology is developed to estimate the overnight capital costs of life extension for fossil-fuel steam plants and to estimate average regional and national life-extension costs. The report discusses the reasons for the current interest in life extension and describes the factors that might influence a utility's decision to life-extend. No attempt is made to compare life extension with other options for meeting demand. In this study, life extension refers to investments made to maintain the operating status of a plant at acceptable levels of availability and efficiency beyond its originally anticipated retirement date. For modeling purposes, refurbishment is assumed to extend the life of a plant approximately 20 years, with availability and efficiency declining over time. More extensive activities, such as repowering a pulverized coal plant with a fluidized bed system or modifying a boiler to use other fuels, are not considered in this report. 8 figs., 17 tabs.

51077 **(EPRI-AP—5965) Rainbow test of advanced coatings for gas turbine blades and vanes.** van Roode, M. (Electric Power Research Inst., Palo Alto, CA (USA); Solar Turbines, Inc., San Diego, CA (USA)). Aug 1988. 142p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016217/JAW.

The principal objective of this program was to carry out a comparative evaluation of the hot corrosion resistance of seven coatings applied to IN-738LC, IN-792 and MAR-M421 first-stage blades and eight coatings applied to FSX-414 and MAR-M509 first-stage vanes in an industrial gas turbine operating on a lower grade distillate fuel. The coatings evaluated included diffusion aluminides and metallic overlays of various compositions. Visual examination, optical metallography and scanning electron microscopy in conjunction with energy-dispersive x-ray analysis were used to evaluate the coated hot section components after a 7940 hour field test in a Centaur T-4000 engine. The metallic overlay coatings showed superior hot corrosion protection on blade platforms and blade airfoil stubs when compared with aluminide diffusion coatings. No differentiation in performance for individual representatives of these two groups of blade coatings could be discerned. The protectiveness of the vane overlay coatings was observed to increase with its chromium content. The metallic overlay vane coatings were more protective than the diffusion aluminides. An exception was the Cr-aluminide which showed comparable performance to a metallic overlay with intermediate chromium content on first-stage vanes. 28 refs., 54 figs., 14 tabs.

51078 **(EPRI-AP—5974) Reliability and availability data for gas turbine generator procurement: Final report.** Shimko, G.; Carlton, J.; Hornady, D.; Smith, A. (Electric Power Research Inst., Palo Alto, CA (USA); Creole Production Services, Inc., Houston, TX (USA); Smith (Andrew), Greenville, SC (USA)). Aug 1988. 144p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015790/JAW.

This publication presents information intended to be helpful in directing gas turbine generation system procurement specifications toward higher reliability and availability. Reliability, Availability, and Maintainability (RAM) considerations were derived from actual operating and maintenance experience on similar equipment. The publication was compiled from data gathered in previous EPRI projects, interviews with operating and maintenance personnel of several EPRI member utilities, the contractor's own experience, and from selected industrial users of gas turbines. Appendices presenting examples of terms that could be used in reliability and maintainability specifications were developed by an EPRI consultant other than CPSI, and appended to CPSI's publication by EPRI.

51079 **(EPRI-EL—5736) Confirmation of test methods for synchronous machine dynamic performance models: Final report.** Rusche, P.A.; Willis, J.R.; Denning, E.L.; Brock, G.J.; de Mello, F.P.; Hannett, L.N. (Electric Power Research Inst., Palo Alto, CA (USA); Consumers Power Co., Jackson, MI (USA); Power Technologies, Inc., Schenectady, NY (USA)). Aug 1988. 313p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015789/JAW.

The economic incentive to increase energy transfer beyond steady state operating limits requires system dynamic performance appraisal for a broad range of conditions. Synchronous machine behavior is one of the parameters affecting this performance. The principal objective of this study was a method, practical for utility companies, to determine synchronous machine parameters for dynamic performance analysis. Numerous methods have been proposed to derive synchronous machine models suitable for system dynamic performance analysis. Park's two-reaction-theory based linear models are adequate for the analysis of small perturbations. Analysis of large disturbances requires inclusion of non-linear effects such as magnetic saturation. Standstill frequency and rotating transient response testing was considered. The tests differed in risk of equipment damage, complexity of the data acquisition and difficulty in model derivation. The methods were comparably applied to four full sized machines and one laboratory machine. Due to proprietary data and software requirements, finite element analysis

using design data was not considered. Aided by a computerized dynamic signal analyzer, the standstill frequency response (SSFR) method was demonstrated to be practical and cost effective. It is the method used by Consumers Power Company when model and parameters are to be determined in the field. Required equipment is commercially available and easily transported in a small van. On the electrically isolated machine, testing can be completed in two shifts. Due to its low power and voltage the tests pose no danger to the equipment. A person trained in Fourier analysis can complete model synthesis in about two weeks. Armature leakage reactance and a no load saturation curve are required for the derivation. 44 refs., 276 figs., 24 tabs.

51080 **(EPRI-EL—5862-Vol.1) Turn insulation capability of large ac motors: Volume 1, Main report: Final report.** Gupta, B.K.; Dick, E.P.; Greenwood, A.; Kurtz, M.; Lauber, T.S.; Lloyd, B.A.; Narang, A.; Pillai, P.R.; Stone, G.C. (Electric Power Research Inst., Palo Alto, CA (USA); Ontario Hydro Research Div., Toronto (Canada); Rensselaer Polytechnic Inst., Troy, NY (USA)). Jul 1988. 199p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94304. Order Number TI88015387/JAW.

Steep fronted transients such as switching surges can cause severe stress on motor turn insulation. Failure of many large ac motors in generating stations have been blamed on switching surges. The introduction of vacuum switchgear has caused particular concern since multiple surges can be generated in each switching operation. This project is aimed at determining the actual surge environment in typical power plants as well as the capability of modern turn insulation to withstand these surges. Laboratory work included studies of the surge distribution within the windings of eleven motor stators, the impulse strength measurements of fifty-three new coils and eighteen motor stators, and testing of vacuum interrupts from five manufacturers. Switching surges were measured on thirty-three motors in sixteen utility plants, covering over 700 normal switching operations. Analytical models for the motor supply system and the motor winding were developed, and validated against the measured results. Switching surges measured on the motors were significantly below the withstand strength of most utility motors. In normal motor switching operations, the risetimes and magnitudes of surges are similar for air-magnetic and vacuum breakers. Although deleterious surge levels cannot be totally ruled out for vacuum switchgear when interrupting motor starting current, it appears that voltage escalation is not a problem for modem vacuum devices applied as recommended by the breaker manufacturers. Practical guidelines are provided for improving motor reliability in new and existing motor installations and for analyzing premature motor failures.

51081 **(EPRI-EL—5862-Vol.2) Turn insulation capability of large ac motors: Volume 2, Appendixes: Final report.** Gupta, B.K.; Dick, E.P.; Greenwood, A.; Kurtz, M.; Lauber, T.S.; Lloyd, B.A.; Narang, A.; Pillai, P.R.; Stone, G.C. (Electric Power Research Inst., Palo Alto, CA (USA); Ontario Hydro Research Div., Toronto (Canada); Rensselaer Polytechnic Inst., Troy, NY (USA)). Jul 1988. 322p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014220/JAW.

Steep fronted transients such as switching surges can cause severe stress on motor turn insulation. Failure of many large ac motors in generating stations have been blamed on switching surges. The introduction of vacuum switchgear has caused particular concern since multiple surges can be generated in each switching operation. This project is aimed at determining the actual surge environment in typical power plants as well as the capability of modern turn insulation to withstand these surges. Laboratory work included studies of the surge distribution with the windings of eleven motor stators, the impulse strength measurements of fifty-three new coils and eighteen motor stators, and testing of vacuum interrupters from five manufacturers. Switching surges were measured on thirty-three motors in sixteen utility plants, covering over 700 normal switching operations. Analytical models for the motor supply system and the motor winding were developed, and validated against the measured results. Switching surges measured on the motors were significantly below the withstand strength of most utility motors. In normal motor switching operations, the risetimes and magnitudes of surges are similar for air-magnetic and vacuum breakers. Although deleterious surge levels cannot be totally ruled out for vacuum devices applied as recommended by the breaker manufacturers.

51082 **(EPRI-EL—5999) Transformer overload characteristics---Bubble evolution.** Woods, E.E.; Wendel, R.C.; Dresser, R.D. (Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Sharon, PA (USA). Materials Mfg. Technology Dept.). Aug 1988. 152p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016611/JAW.

Project RP1289-3 explores significant parameters affecting bubble evolution from transformer oil under high temperature operating conditions to address the question: Does "real life" operation of a transformer cause harmful bubbling conditions? Studies outlined in the project are designed to determine when bubbling occurs in transformers and if bubbling can be harmful during the normal operation of these transformers. Data obtained from these studies should provide a basis for utilities to perform risk assessments in relation to their loading practices. The program is designed to demonstrate those conditions under which bubbling occurs in transformers by using controlled models and actual signal phase transformers that were designed to give access to both high and low voltage windings for the purpose of viewing bubble generation. Results and observations from tests on the full-size transformers, thermal models, and electrical models have led to the conclusion that bubbles can occur under operating conditions. The electrical models show that dielectric strength can be reduced by as much as 40 percent due to the presence of bubbles. Because of factory safety considerations, the transformers could not be tested at hot spot temperatures greater than 140{degree}C. Therefore, there is no information on the dielectric strength of the full-size transformers under bubbling conditions. 4 refs., 28 figs., 45 tabs.

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REFER ALSO TO CITATION(S) 50349, 50350, 50351, 50417, 50418, 50526, 50580, 50651, 51743, 51934, 52067, 52080, 52146, 52147

51083 **(PB—88-209523/XAB) Reactions of nitrogen oxides in power-plant plumes: models and measurements. Doctoral thesis.** Janssen, L.H.J.M. (Technische Hogeschool Delft (Netherlands)). 17 May 1988. 113p. NTIS, PC E05/MF A01.

Summary in Dutch.

Traffic is the most-important source of nitrogen oxides (>50%) in The Netherlands. Generation of electricity in power plants fired with fossil fuel is another important source. The research reported in this thesis was mainly directed to investigations into the competition between the processes of dispersion and mixing and chemical reactions as it affects the conversion rate of in the plumes of power plants. The measurements of concentrations of NO and NO_2 were compared with calculations made with various dispersion models all of which incorporate chemical reactions.

51084 **(SNV—3035) Loudness of power line noise.** Berglund, B.; Berglund, U. (Stockholm Univ. (Sweden). Psykologiska inst.; Statens Miljoemedicinska laboratorium, Stockholm (Sweden). Sektionen foer tillaempad psykofysik). (National Swedish Environmental Protection Board, Solna). Mar 1986. 56p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754420/JAW.

The loudness of power line noises was investigated in five psychoacoustical experiments. Observers judged the loudness of the recorded noises (34-68 dB(A)) with the method of magnitude estimation. The results were: (1) The loudness of power line noise cannot be predicted by loudness calculations according to ISO R532-1966E. (2) Loudness scales can be calibrated with the aid of a Master Scale obtained for a set of sound levels of pink noise. The target and pink noises are scaled jointly in an experiment and the transformation factors for the calibration of the loudness of the target noises is obtained from the psychophysical power functions for pink noise. The loudness of the target noises can then be expressed either in Master Scale units or as the sound level of pink

noise equivalents. (3) The absorption with distance changes. A power line noise that is 56 dB(A) at the transmission line has a 100% detection at 8 m distance (56 dB(A)), a 73% detection at 90 m distance (42 dB(A)), and 67% detection at 215 m distance(36dB(A)). (4) A 20 dB(A) attenuation by ground and atmosphere absorption decreases the loudness more than a 20 dB(A) linear attenuation. In A-weighted pink noise equivalents the decrease in loudness is 30 dB(A) for absorption and 20 dB(A) for linear attenuation; thus 10 dB(A) may be referred to changes in frequency spectrum. (5) Power line noise is more easily masked by road traffic noise than by pink noise. When embedded in a 50-dB(A) traffic noise, power line noise is hard to detect at larger distances than 200 m. If the sound level of traffic noise is 20 dB(A) higher than the power line noise, observers cannot detect the power line noise at all. (6) In the environment, the power line noises usually appear at lower sound levels than most other community noises. (With 44 refs) (authors).

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REFER ALSO TO CITATION(S) 51079, 51082, 51428, 52146, 52147

51085 **(CRIE—U-87036) Effect of DC electric fields on red pine and Japanese cedar trees.** Itaku, Yasunobu; Nakayama, Motoshi; Ogawa, Tadashi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1987. 18p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754536/JAW.

Young seedlings of Japanese pine and Japanese cedar were exposed under DC field to examine and evaluate the influence on the growth of trees to study how to meet the future situation of UHV DC line construction. Elongation of main branches and increment of stem diameter were not influenced by the exposure. Airborne fine particles were adhered to needle tips of Japanese pine as the result of exposure to 120-640V/cm. Remarkably particles adhered to the upper half of pine needles just under the test line, resulting in needle blackening, but as the field strength decreases along with the distance from the test line, adhered particles become smaller and the dirty parts of needles become shorter. Slight browning was observed on the needle tips, which did not influence the main branch growth. (15 figs, 5 refs)

51086 **(CRIE-T—86068) Experimental study on optical power transmission characteristics of small core size optical fibers.** Kuribara, Masayuki; Kurono, Masahiro. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 42p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770178/JAW.

The characteristics of optical power energy transmission using optical fibers were studied through experiments. As a result, the following points were made clear. 1. Low-loss, small-size optical fibers with its core diameter of several ten micrometers can be used for short-distance transmission. However, in the case of long-distance transmission, the efficiency decreases because of the nonlinear optical effect generated in the optical fiber. 2. Large core size optical fiber of several hundred micrometers in diameter is almost immune to the nonlinear optical effect, but the transmission loss is no less than several times or ten times that of ordinary optical fibers for telecommunications. 3. For otical power energy transmission using optical fibers, optimum system design is necessary in consideration of the above two points. 4. Various nonlinear optical effects generated in the optical fibers seem rather useful for optical amplifiers and optical sensors. (21 figs, 7 tabs, 16 refs)

51087 **(CRIE-T—86074) Study to evaluate the performance for lightning location system.** Tomita, Saneyoshi; Kishizima, Isamu; Nishiyama, Takehiko; Matsuda, Koji; Masahashi, Mitsuru. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 34p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770179/JAW.

The performance of a lightning location system which detects electromagnetic waves caused by lightning, locates the point of lightning, and calculates the electric current value has been examined through experiments with real lightnings. As a result, the following points have been made clear. 1. The probability of simultaneous responses from direction finders (hereafter DF) to lightnings in summer was 68%. 2. The direction finding error of the DF was less than 5 degrees. 3. The lightning detection rate in winter was about 50%. 4. The locating error at distances of 80 km and 120 km was about 20 km. The lightning electric current calculated by this system was not compared with actually measured values. In the future, lightning location systems may be integrated into a huge lightning detecting network; however, at the present, knowledge on the accuracy of the system and better understanding of specific characteristics of lightning especially in winter are required. (29 figs, 5 tables, 18 refs)

51088 **(CRIE-W—86011) Studies on artificial lines for synthetic test circuits.** Izumi, Kunikazu; Uemura, Tetsuo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Oct 1987. 44p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770160/JAW.

In order to verify the performance of a power breakers, inherent transient recovery voltage (ITRV) and breaking severities of artificial lines were compared by digital simulations of the distribution line which coincides with the JEC Standard 2300. Concerning SLF artificial line configuration including ITRV (inherent transient recovery voltage) generating artificial line, and on the basis of distribution constant line which coincides with the Standard, optimization including the equivalency was investigated. As a result, practically satisfiable artificial line construction was obtained concerning ITRV generationg artificial line which is applicable to SFL artificial line and BTF/SLF breaking test. Optimum circuit conditions were obtained for the line construction to coincide the oscillation ratio with the minimum standard value in SLF testing line, and for the line construction in consideration of stray capacitance in ITRV generation line. (32 figs, 8 tabs, 9 refs)

51089 **(CRIE-W—87004) Insulation recovery characteristics after are interruption. In cases of V suspension and strain insulator assemblies.** Goda, Yutaka; Matsuda, Shoji; Inaba, Tsuginori. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Sep 1987. 28p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754538/JAW.

Using UHV V suspension and strain insulator assemblies, the insulation recovery time after arc extinction was measured, and the behavior of post arc gas was investigated. The main results include: (1) In case of V suspension insulator assemblies, the insulation recovery time takes 0.7 sec after arc current interruption to withstand 1,440 kV or the biggest switching surge voltage in A.C.UHV system. (2) In case of strain insulator assemblies, if the arc initiates between the horns of insulators, it takes 0.9 sec after arc interruption to withstaned 1,440 kV, and if the arc initiates along the lower surface of the insulators, it becomes 0.2 sec longer than the case of the horns. (3) About buoyancy characteristics of post arc gas, the calculated values of buoyancy height of post arc gas by using a model post arc gas comparatively agree with the measured ones. And the difference of insulation recovery time between V suspension and strain insulator assemblies can be explained by calculated buoyancy heights of the model post arc gases. (14 figs, 2 tabs, 10 refs)

51090 **(CRIE-W—87008) Influences of electrode shapes on the behavior of the arc-jets.** Amakawa, Tadashi; Shibuya, Masatoyo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Nov 1987. 40p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754539/JAW.

The influence of electrode shapes on the behavior of arc-jets were investigsted experimentally. Followings are the results: The arc spot are fixed in the center of a electrode tip except larger electrode diameters or smaller arc currents. The directions of arc-jets have a normal distribution to the electrode axial direction and the standard deviation of 10-15 degrees. But when the arc spots are not fixed in the electrode center, the deviation becomes larger up to 25 degrees. If the arc current is 5-20kA and the electrode is 10cm in diameter with hemispherical tip, the arc-jets expand in the fan

shaped area with 60cm radius and 38 degree around the electrode axis. The angle becomes sharp up to 24 degree in case of the plane electrode. Above results were applied to the new type of jumper horns for 500kV overhead lines to examine the arc stabilizing performance. (19 figs, 5 tabs, 7 photos, 4 refs)

51091 **(ECRC/M—2253) Effect of ionic contaminants on the diffusion of water in cross-linked polyethylene.** Le Poidevin, G.J. (Electricity Council Research Centre, Capenhurst (UK)). Jul 1988. 33p. Available from: Electricity Council Research Centre, Capenhurst, Chester, CH1 6ES, UK.

This report considers the contribution of ionic contaminants in XLPE to the kinetics of water absorption and desorption. A theory is developed to show that the diffusion coefficient of water is proportional to the concentration of impurity and inversely proportional to the square of the water concentration. Formal solutions to the diffusion equation are obtained for absorption and desorption in a semi-infinite medium, when the diffusion coefficient varies approximately in the manner described. These formal solutions are then adapted to the finite sheet, so that the initial absorption and desorption rates calculated for XLPE can be compared with quoted values.

51092 **(HQ—D86-0111) Illustrated vocabulary of underground lines for transport and distribution of electricity. Vol. 1. Cables.** (Hydro-Quebec, Montreal (Canada)). Dec 1986. 156p. (In French). (MICROLOG—88-03002). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e e'tage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This vocabulary is in two parts, the first of which covers cables and their engineering, the second on underground power line construction and maintenance. In each part, the terms are classified by alphabetical order within subdivisions which group them according to a logical sequence. An index at the end of this volume allows the finding of a particular word, starting from either the French term or its English equivalent. The terms presented in the vocabulary have been chosen according to standard international practice, except those relating to specifically North American situations. 53 refs. 136 figs.

51093 **(OH/RD—1987) Applications of high temperature superconducting materials in the power system. An Ontario Hydro perspective.** Chu, F.Y. (Ontario Hydro Research Div., Toronto (Canada)). [1987]. 9p. (CE—01846; CONF-8804188—). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From 2. annual conference of the Association of Energy Management Analysts; Toronto, Canada (11 Apr 1988).

Recent discovery of high temperature superconducting (HTSC) materials has the potential to benefit the electric power system in the future. However, many years of intensive research will be needed to bring the new materials into widespread use in electric utility application. The potential benefits, and the public interest in HTSC, have motivated electrical utilities to examine this technology closely. This paper presents Ontario Hydro's view on potential applications of HTSC in the power system. Such applications include power generation, transmission, and storage; application of HTSC technology to devices outside the electric utility, such as magnetic levitation systems and computers, may also have indirect effects. While the benefits to various aspects of the power system operations can be assessed, the cost for implementation is not clear. This is partly due to the lack of adequate technical information about material properties and fabrication cost. Serious consideration for major component development and implementation will wait for further optimization of material properties that are compatible with the utility operating environment. The short term impact on Ontario Hydro is the immense public interest on the subject. 7 refs., 6 tabs.

51094 **(PB—88-226741/XAB) Fully automated remote control and monitoring system for power-distribution networks.** Fudo, H.; Yukawa, H.; Fukui, T.; Kaga, T.; Noquchi, Y. (Mitsubishi Electric Corp., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01.

Included in Mitsubishi Denki Giho, Vol. 62, No. 3, 10-15(1988).

This article reports on the installation and operation of a fully automated system for remote control and monitoring of distribution-line switches. Coaxial-cable and distribution-line carrier systems were developed from signal-transmission media to improve the power-supply reliability. The power-distribution network is represented on a full-graphic CRT display. The system also employs a full-graphic display-oriented data-maintenance method to reflect changes in the network, greatly simplifying and shortening maintenance.

51095 **Influence of harmonics on power distribution system protection.** Fuller, J.F.; Fuchs, E.F.; Roesler, D.J. (Dept. of Electrical and Computer Engineering, Univ. of Colorado, Boulder, CO (US)). *IEEE Transactions on Power Delivery;* **3**: No. 2, 549-557(Apr 1988).

The effects of nonsinusoidal voltages and currents on the performance of static underfrequency and overcurrent relays were experimentally studied. The tests were conducted such that the frequency, amplitude and phase shift of individual harmonics could be adjusted in a controlled manner by employing a waveform generator with a phase-locking circuit. The relation between the harmonic currents and voltages was modelled through the power system impedances within residential distribution systems. It was found that for harmonic voltage and current amplitudes, as they occur in distribution systems, underfrequency relays and the time delay operation of overcurrent relays show a marked deterioration in their performance. The instantaneous operating characteristics of overcurrent relays, however, are hardly affected by the presence of harmonic currents.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 51380, 52901

51096 **(WHC-SA—0207) Monte Carlo applications for the design and operation of nuclear facilities.** Carter, L.L.; Bunch, W.L.; Morford, R.J.; Wootan, D.W.; Schwarz, R.A. (Westinghouse Hanford Co., Richland, WA (USA)). Jun 1988. Contract AC06-87RL10930. 12p. (CONF-880906—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015594/JAW.

From 7. international conference on radiation shielding; Bournemouth, UK (12 Sep 1988).

The computational capabilities of current supercomputers enable the application of rigorous Monte Carlo methods to solve day-to-day neutronics and shielding problems. Experience at Westinghouse Hanford Company has included applications to: reactor operations, decommissioning of a reactor facility, and the design of a space reactor; intermediate energy accelerators; and high-level waste facilities and casks. These practical applications are typically computationally intensive because of the amount of information required. A number of practical examples are discussed. An increase in effective computer capabilities would further enhance the use of Monte Carlo methods. 16 refs., 4 figs., 2 tabs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 50738, 50739, 50744, 50746, 50794, 51215, 51228, 51249, 51251, 51252, 51253, 51257, 51266, 51267, 51271, 51274, 51275, 51277, 51283, 51285, 51287, 51297, 51305, 51306, 51307, 51308, 51311, 51313, 51315, 51324, 51327, 51328, 51329, 51330, 51332, 51610

51097 **(CONF-880557—2) Nonlinear dynamics and chaos in boiling water reactors.** March-Leuba, J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012927/JAW.

From NATO advanced research workshop on noise and nonlinear phenomena in nuclear systems; Valencia, Spain (23 May 1988).

There are currently 72 commercial boiling water reactors (BWRs) in operation or under construction in the western world,

37 of them in the United States. Consequently, a great effort has been devoted to the study of BWR systems under a wide range of plant operating conditions. This paper represents a contribution to this ongoing effort; its objective is to study the basic dynamic processes in BWR systems, with special emphasis on the physical interpretation of BWR dynamics. The main thrust in this work is the development of phenomenological BWR models suited for analytical studies performed in conjunction with numerical calculations. This approach leads to a deeper understanding of BWR dynamics and facilitates the interpretation of numerical results given by currently available sophisticated BWR codes. 6 refs., 14 figs., 2 tabs.

51098 **(EPRI-NP—5840) Qualification of RETRAN for simulator application: Final report.** Harrison, J.F.; Lautzenheiser, J.C.; Beck, W.C.; Loomis, J.N. (Electric Power Research Inst., Palo Alto, CA (USA); WOTEC, Inc., Stuart, FL (USA)). Jul 1988. 863p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014528/JAW.

This report provides an assessment of RETRAN'S ability to be used to provide best estimate reference information for the qualification of full-scope power plant training simulators. RETRAN analyses which compare RETRAN predictions to the plant data or the test facility data are summarized. The relationship between the RETRAN qualification studies and the simulator test matrix presented in EPRI NP-424, Analytic Simulator Qualification Methodology, and the requirements of ANSI/ANS-3.5 are discusses.

51099 **(HEDL—7601) LWR Pressure Vessel Surveillance Dosimetry Improvement Program for NRC [Nuclear Regulatory Commission] Materials Engineering Branch: 1985 summary annual report.** McElroy, W.N. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-76FF02170. 60p. (NUREG/CR—4307-Vol.2). NTIS, PC A04/MF A01 - GPO. Order Number TI88012301/JAW.

The objective of this program is to make measurements in neutron fields ("Benchmark" and reactor "Test Surveillance Regions") for the subsequent validation/calibration of available state-of-the-art physics-dosimetry-metallurgy, damage correlation, and associated reactor analysis procedures and data. These procedures and data are in turn used for predicting the integrated effects of neutron exposure to Light Water Reactor (LWR) Pressure Vessel (PV) and support structure steels from the results of research reactor tests and power reactor surveillance programs. The program work includes: (1) selection of the neutron field, (2) validation/calibration of physics-dosimetry-metallurgy, damage correlations, and the associated reactor analysis procedures and data using these fields, (3) preparation and editing of a series of 22 supporting NUREG reports, and (4) preparation and establishment of a set of 21 ASTM-recommended standard Practices, Guides, and Methods. 53 refs., 12 figs., 14 tabs.

51100 **(IAEA-TECDOC—451) Some practical implications of source term reassessment.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704111/JAW.

This report provides a brief summary of the current knowledge of severe accident source terms and suggests how this knowledge might be applied to a number of specific aspects of reactor safety. In preparing the report, consideration has been restricted to source term issues relating to light water reactors (LWRs). Consideration has also generally been restricted to the consequences of hypothetical severe accidents rather than their probability of occurrence, although it is recognized that, in the practical application of source term research, it is necessary to take account of probability as well as consequences. The specific areas identified were as follows: Exploration of the new insights that are available into the management of severe accidents; Investigating the impact of source term research on emergency planning and response; Assessing the possibilities which exist in present reactor designs for preventing or mitigating the consequences of severe accidents and how these might be used effectively; Exploring the need for backfitting and assessing the implications of source term research for future designs; and Improving the quantification of the radiological consequences of hypothetical severe accidents for probabilistic safety assessments (PSAs) and informing the public about the realistic risks associated with nuclear power plants. 7 refs.

51101 **(INIS-mf—11809) KKP 1. Report to inform the Reactor Safety Commission. Period covered: January 1 to December 31, 1987.** (Kernkraftwerk Philippsburg G.m.b.H. (Germany, F.R.)). 1987. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754657/JAW.

This report goes into details of the operation during its reporting period, giving the total activity in the primary events. Radiation exposure, activities, dose rates of persons, collective doses from activity and radioactive emission to water and waste air are given. Account is given of all modifications or extensions made on safety-related parts of the plant, on controls and regulation.

51102 (JAERI-M—88-065, pp 119-134) **Benchmark tests of JENDL-3T for thermal reactor and high conversion light water reactor.** Takano, Hideki; Kaneko, Kunio. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Benchmark tests of JENDL-3T data were performed by analysing a lot of critical experiments, and the results were compared with those obtained using JENDL-2 data. The benchmark calculations were performed with SRAC, a thermal reactor standard code system for reactor design and analysis. For these calculations, a SRACLIB-JENDL3T library was produced with the processing codes, TIMS-PGG and SRACTLIB. The calculated results are summarized as follows: (1) U-235 fuel cores : The k/sub eff/ calculated with JENDL-3T cross sections increased about 0.3 % with respect to the JENDL-2 based values. The increase reflects the 0.24 % increase in ν-235 at the 2200 m/sec. However, for the case of the metal fuel core with a hard spectrum, the k/sub eff/ obtained with JENDL-3T increased about 2 % with respect to the JENDL-2 value. This is due primary to larger ν-235 values (2 %) in fast energy region and a hard Madland-Nix fission spectrum in JENDL-3T. (2) Pu-239 fuel cores : The k/sub eff/ calculated with JENDL-3T data decrease about 0.6 % with respect to the JENDL-2 values. It is seemed that this is due to lower fission cross sections of Pu-239 in resolved resonance region. The lower fission cross sections cause a overestimation for conversion ratio in PROTEUS core of HCLWR. (3) U-233 fuel cores : The k/sub eff/ obtained with JENDL-3T data decrease 0.5 - 2.5 % with respect to JENDL-2 values, excepting for the case of metal fuel core with hard neutron spectrum.

51103 (JAERI-M—88-065, pp 330-343) **Activation of structural materials due to recoil protons in light water reactor.** Takahashi, M.; Yuasa, Y.; Iijima, S.; Murata, T. (Nippon Atomic Industry Group Co. Ltd., Tokyo). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The long-lived radioactivities of structural materials induced by recoil protons in BWR were estimated for land disposal of low level waste after reactor decommisioning. Reactions of interest are listed. Method of calculation of the proton spectrum in materials was developed. A program PEGASUS-P was developed by modifying PEGASUS to calculate proton induced reaction cross sections. The proton-induced activities are shown as not exceeding 1/1000 of that of a typical neutron induced nuclide, Ni-63, for cooling up to 1000 years after irradiation of 40 years.

51104 **(NUREG—0813) Final environmental statement related to the operation of Callaway Plant, Unit No. 1 (Docket No. 50-483).** (Nuclear Regulatory Commission, Washington, DC (USA); Union Electric Co., St. Louis, MO (USA)). Jan 1982. 201p. NTIS, PC A10/MF A01 - GPO. Order Number TI88016397/JAW.

The final environmental statement contains the second assessment of the environmental impact associated with operation of Callaway Plant Unit 1, pursuant to the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Par 51, as amended, of the NRC's regulations. This statement examines: the purpose and need for the Callaway project, alternatives to the project, the affected environment, environmental consequences and mitigating actions, and environmental and economic benefits and costs. No water-use impacts are expected from cooling-tower markup withdrawn from, or blowdown discharged into, the Missouri River. Land-use and terrestrial- and aquatic-ecological impacts will be small. Air-quality impacts from cooling-tower drift and other emissions and dust will also be small. Impacts to historic and prehistoric sites will be negligible with the development and implementation of the applicant's cultural-resources management plan. No significant impacts are anticipated from normal operational releases of radioactivity. The risk associated with accidental radiation exposure is very low. The net socioeconomic effects of the project will be beneficial. The action called for is the issuance of an operating license for Unit 1 of the Callaway Plant. 18 figs., 16 tabs.

51105 **(NUREG—0975-Vol.6) Compilation of contract research for the Materials Engineering Branch, Division of Engineering: Annual report for FY 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Jun 1988. 423p. NTIS, PC A18/MF A01 - GPO. Order Number TI88013182/JAW.

This compilation of annual reports by contractors to the Materials Engineering Branch of the NRC Office of Research concentrates on achievements in safety research for the primary system of commercial light water power reactors, particularly with regard to reactor vessels, primary system piping, steam generators, nondestructive examination of primary components, and in safety research for decommissioning and decontamination, on-site storage, and engineered safety features. This report, covering research conducted during Fiscal Year 1987 is the sixth volume of the series of NUREG-0975, "Compilation of Contractor Research for the Materials Engineering Branch, Division of Engineering."

51106 **(NUREG/CR—4219-Vol.5-No.1) Heavy-section steel technology program: Semiannual progress report for October 1987--March 1988.** Corwin, W.R. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 257p. (ORNL/TM—9593/V5-N1). NTIS, PC A13/MF A01 - GPO. Order Number TI88015348/JAW.

These studies relate to all areas of the the technology of materials fabricated into thick-section primary-coolant containment systems of light-water-cooled nuclear power reactors. The focus is on the behavior and structural integrity of steel pressure vessels containing cracklike flaws. Improvements were made in the computational efficiencies of fracture-analysis codes, enhancements were made in the constitutive models and inelastic fracture criteria in the dynamic-viscoplastic fracture version of the ADINA-ORMGEN-ORVIRT analysis codes at Oak Ridge National Laboratory (ORNL). Elastodynamic analyses and development work on viscoplastic fracture-analysis techniques were performed. Three new areas were begun: (1) the evaluation of possible enhanced low-temperature, low-flux irradiation embrittlement of reactor pressure vessel supports; (2) an assessment of boiling-water-reactor vessel integrity; and (3) a reevaluation of the applicability of various formulations of the J-integral in assessing relatively large amounts of crack extension. One additional wide-plate, crack-arrest test was performed. Crack-arrest and other fracture characterization data were obtained for clad-plate test materials. All irradiated Charpy V-notch and tensile testing was completed for the second phase of the the Seventh HSST Irradiation Series on cladding. Nondestructive examinations were completed on a segment of a clad pressurized-water reactor (PWR) vessel. 141 refs., 208 figs., 27 tabs.

51107 **(EPRI-NP—4574-CCM-Pt.2-Ch.4) ARMP-02 documentation: Part 2, Chapter 4, The EPRI-CPM data library.** Edenius, M.; Ekberg, K.; Haeggblom, H. (Electric Power Research Inst., Palo Alto, CA (USA); Nuclear Associates International Corp., Rockville, MD (USA); Aktiebolaget Atomenergi, Studsvik (Sweden)). Aug 1988. 58p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016083/JAW.

This chapter describes the multigroup cross section library generated for use with the EPRI-CPM and MICBURN codes. This same library is used with the CPM-2 and MICBURN-E codes.

51108 **(EPRI-NP—4574-CCM-Pt.1-Chs.1-7) ARMP-02 documentation: Part 1, Chapters 1-7: Overview and system benchmarking.** (Electric Power Research Inst., Palo Alto, CA (USA); Nuclear Associates International Corp., Rockville, MD (USA); Science Applications International Corp., McLean, VA (USA); Levy (S.), Inc., Campbell, CA (USA)). Aug 1988. 413p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016185/JAW.

This document is an overview of the ARMP-02 Documentation. The Documentation consists of Benchmarking Summaries in Part 1, Code Manuals in Part II, and LWR Design Procedure Manuals in Part III. The ARMP-02 Methodology benefitted greatly from experience acquired with the original ARMP release. The development process retained well-tested engineering procedures, but replaced every physics and data processing module of the original release. In addition, the ENDF/B-V cross sections have been introduced as well as automated systems capable of generating the comprehensive data bases required by current sophisticated transient analysis codes such as ARROTTA, BEAGL, RETRAN, etc.

51109 **Singular perturbation analysis of limit cycle behavior in nuclear-coupled density-wave oscillations.** Ward, M.E.; Lee, J.C. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)). *Nuclear Science and Engineering;* **97**: No. 3, 190-202(Nov 1987).

An investigation of the potential behavior of large amplitude nuclear-coupled density-wave oscillations in a boiling water reactor (BWR) was performed. A simplified, nonlinear BWR core model was developed and used to predict the growth of oscillations as a limit cycle is approached. For high-power/low-flow initial conditions, large density-wave oscillations could cause periodic pulses in core power. The fuel temperature, which rapidly increases at high-power conditions and slowly recovers, is considered as the fast variable in a relaxation oscillation. With an appropriate transformation of the system equations, the approximate limit cycle trajectory can therefore be determined using singular perturbation analysis.

51110 **Transient two-phase channel flow for nonuniform axial heat fluxes.** Arnold, G.; Lahey, R.T. Jr. *Transactions of the American Nuclear Society;* **55**: 368-370(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The analysis of transients in boiling channels is essential in the evaluation of thermal margin. Indeed, the occurrence of critical heat flux is much more likely during transient conditions than for steady-state operations. This paper presents a closed-form analytical solution for a flow transient in a boiling channel having a nonuniform axial heat flux. Similar solutions have been obtained previously for uniform axial heat flux distribution using homogeneous and drift-flux models. No previous analytical solutions have been published for flow transients in boiling channels having nonuniform axial heat flux profiles. The flow transient to be investigated consists of a step change in inlet flow rate. Since all flow transients may be decomposed into a finite number of steps, this incurs no loss in generality. Moreover, this transient permits a simple solution to be readily derived. To maintain tractability, only the case of no inlet subcooling is considered in this paper. Although this problem has been simplified, the results are useful for the assessment of computer codes used in the transient analysis of two-phase flow.

51111 **Methodology for global nonlinear analysis of nuclear systems.** Cacuci, D.G.; Cacuci, G.L. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 374-376(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Addressing the increasing demands on the reliability, safety, and efficiency of nuclear systems has stimulated the development of increasingly more powerful methods of analysis. A recurring diffi-

culty in the development of such methods has been the proper treatment of nonlinearities that occur in virtually every aspect of modeling the nuclear system's behavior. Important examples of such occurrences are in optimal reactor control, in-core optimization of fuel reloading and depletion, reactor thermal hydraulics, reactor and/or plant dynamics, and sensitivity analysis. Nonlinear problems are notoriously difficult to solve. This paper outlines a general method for globally computing the crucial features of nonlinear problems: bifurcations, limit points, saddle points, extrema (maxima and minima); our method also yields the local sensitivities (i.e., first-order derivatives) of the system's state variables (e.g., fluxes, power, temperatures, flows) at any point in the system's phase space. It also presents an application of this method to a nonlinear boiling water reactor (BWR) model.

51112 **Storage of burned PWR and BWR fuel.** Turner, S.E. *Transactions of the American Nuclear Society;* **55**: 394-395(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In the last few years, credit for fuel burnup has been allowed in the design and criticality safety analysis of high-density spent-fuel storage racks. Design and operating philosophies, however, differ significantly between pressurized water reactor (PWR)- and boiling water reactor (BWR)-type plants because: (1) PWR storage pools generally use soluble boron, which provides backup criticality control under accident conditions; and (2) BWR fuel generally contains gadolinium burnable poison, which results in a characteristically peaked burnup-dependent reactivity variation. In PWR systems, the reactivity decreases monotonically with burnup in a nearly linear fashion (excluding xenon effects), and a two-region concept is feasible. In BWR systems, the reactivity is initially low, increases as fuel burnup progresses, and reaches a maximum at a burnup where the gadolinium is nearly depleted. In any spent-fuel storage rack design, uncertainties due to manufacturing tolerances and in calculational methods must be included to assure that the highest reactivity (k/sub eff/) is less than the 0.95 US Nuclear Regulatory Commission limit. In the absence of definitive critical experiment data with spent fuel, the uncertainty due to depletion calculations must be assumed on the basis of judgment. High-density spent-fuel storage racks may be designed for both PWR and BWR plants with credit for burnup. However, the design must be tailored to each plant with appropriate consideration of the preferences/specifications of the utility operating staff.

51113 **Past experience and future needs for the use of burnup credit in LWR fuel storage.** Boyd, W.A.; Wrights, G.N. *Transactions of the American Nuclear Society;* **55**: 396(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

To achieve improved fuel economics and reduce the amount of fuel discharged annually, utilities are engaging in fuel management strategies that will achieve higher discharge burnups for their fuel assemblies. Although burnup credit methodologies have been developed and spent-fuel racks have been licensed, burnup credit fuel storage racks are not the answer for all utilities. Off-site and out-of-pool spent-fuel storage may be more appropriate. This is leading to the development of dry spent-fuel storage and shipping casks. Cask designs with spent-fuel storage capability between 20 and 32 assemblies are being developed by several vendors. The US Dept. of Energy is also funding work by VEPCO. Westinghouse is currently licensing its dry storage cask, developing a shipping cask for the domestic market, and is involved in a joint venture to develop a cask for the international market. Although methods of taking credit for fuel burnup in spent-fuel storage racks have been developed and licensed, use of these methods on dry spent-fuel storage and shipping casks can lead to new issues. These issues arise because the excess reactivity margin that is inherent in a burnup credit spent-fuel storage rack criticality analysis will not be available in a dry cask analysis.

51114 **Instrumentation for measuring the burnup of spent nuclear fuel.** Libby, R.A.; Bierman, S.R. (Pacific Northwest Lab., Richland, WA (USA)). *Transactions of the American Nuclear Society;* **55**: 401(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Many different methods or procedures have been developed to measure reactivity of fissil materials. Few of these, however, have been designed specifically for light water reactor fuel or have actually been used to measure the reactivity of spent fuel. The methods that have been used to make measurements of related systems are the ^{252}Cf source-driven noise analysis method, a noise analysis method using natural neutron sources, subcritical assembly measurements, and pulsed neutron techniques. Several different approaches to directly measuring burnup have been developed by various organizations. The experimental work on actual spent nuclear fuel utilizing reactivity measurement techniques is insufficient to provide conclusive evidence of the applicability of these techniques for verifying fuel burnup. The work with burnup meters indicates, however, that good correlations can be obtained with any of the systems. A burnup meter's primary function would be a secondary assurance that the administrative records are not grossly in error. Reactivity measurements provide information relating to the reactivity of the fuel only under the conditions measured. Criticality prevention design requirements will necessitate that casks accommodate a minimum burnup level for a given initial enrichment (i.e., a maximum reactivity). Direct measurement of the burnup will enable an easy determination of whether a particular fuel assembly can be shipped in a specific cask with a minimum number of additional correlations.

51115 **Evaluation of the ^{252}Cf-source-driven neutron noise analysis method for measuring the subcriticality of LWR fuel storage casks.** Mihalczo, J.T. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 402-403(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The ^{252}Cf-source-driven neutron noise analysis method was evaluated to determine if it could be used to measure the subcriticality of storage casks of burnt light water reactor (LWR) fuel submerged in fuel storage pools, fully loaded and as they are being loaded. Measurements of k/sub eff/ would provide the parameter most directly related to the criticality safety of storage cask configurations of LWR fuel and could allow proper credit for fuel burnup without reliance on calculations. This, in turn, could lead to more cost-effective cask designs. Evaluation of the method for this application was based on experiments already completed at a critical experiments facility using arrays of pressurized water reactor (PWR) fuel pins typical of the size of storage cask configurations, the existence of neutron detectors that can function in shipping cask environments, and the ability to construct ionization chambers containing ^{252}Cf of adequate intensity for these measurements.

51116 **Burnup credit in the storage of LWR fuel - conceptual considerations.** Brown, O.C.; Wimpy, P.D. *Transactions of the American Nuclear Society;* **55**: 403-405(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

As a natural outgrowth of improved nodal calculation methods and the accessibility of detailed fuel assembly operating data from core monitoring systems, taking credit for burnup in the storage of light water reactor fuel represents a logical alternative to reracking for storing higher enriched fuel. The paper summarizes a number of array reactivity calculations that indicate: (1) taking credit for burnup leads to significantly lower array k/sub eff's/; (2) axial exposure distribution effects on array reactivity increase with exposure and are more significant in BWR than PWR fuel; (3) BWR fuel void history effects on array reactivity can be significant; and (4) an array of all fresh 3.83 wt% enriched PWR fuel is equivalent in array reactivity to a checkerboard array of 20 GWd/tonne U and fresh fuel enriched to 5.1 wt%. One approach to minimizing operator error in the handling of assemblies would be to first select and store exposed fuel in a checkerboard arrangement throughout the array. These cells could then be capped with a lockout device to preclude removal with the grappling machine. Once these assemblies were in place, all other assemblies could be safely stored in any other available cell.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 50738, 50739, 50744, 50746, 50858, 51098, 51099, 51100, 51102, 51105, 51106, 51108, 51112, 51113, 51114, 51115, 51116, 51213, 51215, 51221, 51222, 51250, 51257, 51260, 51266, 51275, 51280, 51283, 51285, 51286, 51287, 51296, 51297, 51302, 51303, 51304, 51312, 51314, 51316, 51317, 51319, 51322, 51323, 51324, 51325, 51326, 51331, 51332, 51610, 51910

51117 (CEA-CONF—9341) Evaluation of the french studies for the detection and sizing of subcladding cracks in case of an eventual propagation. Martin, E.; Samman, J.; Charbonnier, J.F.; Saglio, R.; Serre, M.; Asty, M. (Electricite de France, 93 - Saint-Denis; Societe Intercontrole, 94 - Rungis (France)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 9p. (CONF-871022—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754779/JAW.

From International conference on materials for nuclear reactor core applications; Bristol, UK (27 Oct 1987).

In 1979 subcladding cracks were discovered inside the nozzles of the french PWR vessels. The purpose of this paper is to outline the main steps of the study which were undertaken to detect efficiently subcladding defects, then to develop a sizing method.

51118 (CEA-CONF—9347) Disassembling and rebuilding 900 MW unit fuel assemblies in Celimene. Giquel, G.; Leseur, A.; Pillet, C.; Van Craeynest, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 10p. (CONF-8711221—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754784/JAW.

From International Atomic Energy Agency technical committee meeting on underwater inspection, repair and reconstitution of water reactor fuel; Paris, France (3 Nov 1987).

The Celimene high activity laboratory, in the Nuclear Research Centre of Saclay, has equipment for and experience of disassembling and rebuilding fuel assemblies from 900 MW light water reactors. These operations have been performed for R and D purposes; they allow removal for investigation of some of the fuel rods and examination of the skeleton. The rebuilt assemblies are sent to the fuel reprocessing plant. Reirradiation of these assemblies has not been considered so far and would require modifications of the procedure and of parts of the new skeleton. Disassembling and rebuilding have already been performed on three assemblies and a fourth one will be rebuilt in the coming months.

51119 (CEA-CONF—9354) Manufacture controls and in-site examinations for PWR fuels. Chenebault, P.; Marin, J.F.; Beuneche, D.; Gebelin, B. and others. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR). Dept. de Technologie; Fragema, 69 - Lyon (FR)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 24p. (In French). (CONF-8711204—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754787/JAW.

From SFEN day on PWR non destructive testing; Paris, France (24 Nov 1987).

In this paper the authors give the main non destructive controls used in the manufacture and in the reactor pools for PWR fuels.

51120 (CEA-N—2556) Study of neutronic problems related to the xenon instability in the pressurized water reactor. Mathonniere, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques; Paris-11 Univ., 91 - Orsay (France)). Mar 1988. 262p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754790/JAW.

Xenon instabilities lead to increase initial errors. So it is extremely difficult to get an accurate calculation schema able to deal with these problems which are very important for electrical grid whose electronuclear output is large. The main task was to build a tridimensional calculation schema including nuclear, thermal hydraulic feedback. It was qualified by comparing its results with an actual experiment. Many technical problems were investigated through analytical studies or calculation results: time step, spatial mesh, finite element, convergence criterion, modelization for grids and fast control rod moves. Moreover, a 1D model, for less expensive, was studied. Its comparison with the 3D results allowed to check its accuracy and to validate the modelization of the radial laplacien and the modelization of the control rods.

51121 (EPRI-NP—5963) Lamb wave inspection for large cracks in centrifugally cast stainless steel: Interim report. (Electric Power Research Inst., Palo Alto, CA (USA); Georgetown Univ., Washington, DC (USA). Dept. of Physics). Aug 1988. 106p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015354/JAW.

The objective of the present research project is to develop an inspection technique to detect and size large-scale cracks in centrifugally cast stainless steel (CCSS) pipes. This technique is based on the use of Lamb waves, or generally the resonant modes of propagation in the considered geometry, to circumvent the difficulties encountered when the conventional ultrasonic bulk waves are used to inspect the anisotropic, highly absorptive CCSS material. The research activities in 1987 were focused on probe design, Lamb-wave mode selection and excitation, detection mechanism, and anisotropy and curvature effects. The optimal design of a laboratory search unit was determined to be a tandem dual-element system built on the liquid-wedge principle. A reliable mechanism, which features a strong amplitude reduction when the search unit is scanned over a crack, was identified for crack detection and location. The preliminary experimental and analytical findings indicate that the best resonant modes were identified to be the four lowest modes in light of their excitability and minimization of the anisotropy effect. Finally, for typical geometrical dimensions under consideration, the curvature effect was found to be minimal.

51122 (EPRI-NP—5985) Boric acid corrosion of carbon and low-alloy steel pressure-boundary components in PWRs: Final report. O'Neill, A.S.; Hall, J.F. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA)). Aug 1988. 42p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016215/JAW.

This report presents the results of a literature survey of the effects of borated water leakage on carbon and low-alloy steel components (other than fasteners) in PWR applications. Boric acid corrosion field experience and laboratory test results are addressed. The report reviews and summarizes corrosion events that have occurred in PWRs and provides, for each event, plant identification, year of occurrence, component or part affected, materials, leak rates (where available), extent of corrosion and repair procedures. Laboratory test data are also discussed, including some recent unpublished data. The report recommends corrective actions that the utilities should take to prevent boric acid corrosion of pressure boundary components. 18 refs., 3 figs., 4 tabs.

51123 (FRCEA-TH—62) Modeling and interpretation of the physical phenomena inducing noise on PWR's ex-core and in-core detectors signals. Potentialities of an on-line surveillance based on this noise measurement and analysis. Messainguiral, C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. des Reacteurs a Eau; Paris-11 Univ., 91 - Orsay (France)). 1987. 231p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88754793/JAW.

The study of the 900 MW PWR's ex-core neutron sensors signal fluctuations and their interpretation were to be carried out in this work. The aim, at the end was to be able to decide what could be the possibilities and the limits of a surveillance based on the pressurized water reactors neuton noise analysis. Hence, all the perturbation sources whether they are currently present or just may occur, were to be studied under their two aspects: qualitative and quantitative. The small amplitudes of the perturbations to be considered allowed their effect on the neutron detector signals to be calculated with the first order approximation of the perturbation theory model. We developed the model and the computer software which carried out the calculation of the detectors signal sensitivity

to the perturbations that were considered. Moreover, our work was supported by numerous on-site measurements, carried out on many reactors. The following facts can be extracted from the work: - neutron noise analysis allows the vibrational behavior characterization of some primary circuit main components, at locations where no direct vibratory measurements can be generally considered, - some signatures corresponding to unsuitable behaviors were obtained, - other signatures typical of unsuitable behaviors, though not observed, have been defined, - besides the vibratory area, neutron noise may be used for the characterization of the detector state itself, - in the thermohydraulical field , and for PWRs, the neutron noise possibilities have to be considered as rather low though not zero.

51124 **(INIS-BR—1226) Status of PWR safety engineering in Germany.** Schenk, H. (Academia Brasileira de Ciencias, Rio de Janeiro). 1986. 46p. (CONF-8608221—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704018/JAW.

From Workshop on PWR reactor safety; Rio de Janeiro, Brazil (11 Aug 1986).

The basic principles of the German reactor safety concept are presented. (E.G.).

51125 **(INIS-BR—1227) Technical and institutional aspects of nuclear reactor safety in Brazil.** Rosa, L.P. (Academia Brasileira de Ciencias, Rio de Janeiro). 1986. 25p. (In Portuguese). (CONF-8608221—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704019/JAW.

From Workshop on PWR reactor safety; Rio de Janeiro, Brazil (11 Aug 1986).

The aspect of nuclear reactor safety in Brazil is discussed, mixing technical aspects and political aspects. (E.G.).

51126 **(INIS-BR—1228) Safety experience on EDF's PWRs.** Tanguy, P. (Academia Brasileira de Ciencias, Rio de Janeiro). 1986. 20p. (CONF-8608221—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704020/JAW.

From Workshop on PWR reactor safety; Rio de Janeiro, Brazil (11 Aug 1986).

The french nuclear programme has been widely publicized. In 1985, the total nuclear electricity generated was around 216 GWh, i. e. 70% of the electricity produced by electricity de France (EDF). If we consider only pressurized water reactors, at the end of 1985, 37 units were in operation (32 900 MWe and 5 1300 MWe) and 18 were under construction. I intend to review our experience with the safety of PWR's, but I will first present briefly some aspects related to the safety organization in France and the standardization policy.

51127 **(INIS-GB—164) Hinkley Point 'C': a summary of the Environmental Statement.** (Central Electricity Generating Board, London (UK)). Aug 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754917/JAW.

The Environmental Statement describes the potentially significant environmental effects of the proposed pressurized water reactor station at Hinkley Point in Somerset, and the ways in which the Central Electricity Generating Board (CEGB) intends to avoid, reduce or remedy these effects. It also explains the CEGB's reasons for proposing a PWR at Hinkley Point. The Environmental Statement has been produced to inform local authorities, the public and the Secretary of State for Energy about the CEGB's proposals. The Secretary of State has to decide whether or not consent for construction of Hinkley Point 'C' power station should be given, and in reaching that decision has to consider, amongst other matters, the environmental effects of the project. This summary and the Environmental Statement also describe the CEGB's plans for developing Hinkley Point 'C. Some details are yet to be finalised and may be subject to change, but this will not affect the overall validity of the environmental analysis given in these documents. Greater detail can be found in the full Environmental Statement.

51128 (INIS-SU—38/A, pp 60-63) **Calculational and experimental investigation into evaporation process in small leakage accidental conditions.** Bajkova, E.V.; Balashov, S.M.; Gordon, B.G.; Kon'kov, A.S.; Shlesberg, S.G. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

Reproduction of boiling process taking place in the reactor core in a small break accidental conditions was the purpose of the calculational and experimental investigation, some results of which are presented in the paper. The experiments are conducted on two assemblies of dummy fuel rods with thermal properties close to natural fuel elements. The experimental results make it possible to study dynamics of two-phase and weight level behaviour as well as temperature mode of fuel elements. The calculations conducted on the basis of the solution of conservation equations in combination with the equation of the drift flow model were corrected by the obtained experimental data. Comparison of the calculations with the experiment have revealed that the calculational model satisfactorily describes the process of boiling. Besides, the experimental data permit to specify and improve the calculational model of heat exchange in the range of worsened heat transfer. 4 refs.; 3 figs.

51129 (INIS-SU—38/A, pp 85-87) **Key features of natural convection calculation in steam generators of NPP with WWER.** Galetskij, N.S.; Lokshin, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

Steam generation in intertubular space and natural convection of medium through unprotected free-submerged evaporating tube packages is one of the specific features of hydraulic processes in horizontal steam generators. That is why data on peculiarities of motion of steam-water flow under these conditions are required for calculation of convection. Peculiarities of "non-organized" convection are investigated, and the technique of its calculation is developed. The results well coincide with data on hydrodynamic tests of steam generators of WWER-440 units and steam generators of WWER-1000 units in the range of medium and low heat loads. 2 refs.; 2 figs.

51130 **(KFKI—1987-67/G,M) WWER-1000 core physical model.** Gado, J.; Szatmary, Z. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 40p. (In Hungarian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703424/JAW.

A program system proposed for physical core modelling of WWER-1000 type power reactors is described. It should be capable to solve any problems in this aspect, therefore it is designed with a structure that makes possible all calculations to be emerging in the future. In this proposal the modular program development up to 1990 in outlined but also problems to be solved after 1990 will be considered. First, the core physical problems to be solved are overviewed here. (R.P.) 7 refs.

51131 **(KFKI—1987-68/G,M) Thermohydraulic model of WWER-1000 core.** Maroti, L.; Szabados, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 22p. (In Hungarian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703425/JAW.

Safe and economic operation of the WWER-1000 type reactor requires more accurate calculation of the thermohydraulic processes than the one satisfactory for the 440 type cores. The high degree of accuracy is needed both for reactor physics calculations and for the determination of the operational safety limits of the core. The paper illustrates the most important differences between the 1000 and 440 type reactors and presents the main fields of the development work necessary to reach the required accuracy. A prediction for the capability of the computer programs after the proposed development is also given and some suggestions for the further improvement is outlined. (author) 7 refs.

51132 **(KFKI—1987-76/G) Reactor operation based on subchannel approach at the WWER-440 reactor of the Paks Nuclear Power Plant Pt. 2. Theoretical and experimental study of transient processes following pump blockage.** Szabados, L.; Biro, Edit; Ezsoel, Gy.; Maroti, L.; Perneczky, L.; Toth, I.; Trosztel, I.; Vigassy, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Nov 1987. 200p. (In Hungarian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88703430/JAW.

For the theoretical investigation of the breakdown caused by the blockage of the rotor of the main circulating pump at the Paks Nuclear Power Plant experiments were carried out at the PMK-NVH high pressure loop of the Central Research Institute for Physics of the Hungarian Academy of Sciences, Budapest. Transients caused by the blockage of one pump out of four and six were studied. Preliminary calculations and data evaluations were made by means of the Cobra-3C/KFKI code. According to the major parameters such as pressure, temperature, void content, the transients cannot be regarded 'eventful'. According to the calculations about hot channel operation it can be stated that even under bad conditions DNBR/sub min/ is not lower than 1.25. (V.N.) 9 refs.; 89 figs.

51133 **(KFKI—1987-81/G) Simulation of the dynamic behaviour of the secondary circuit of a WWER-440 type nuclear power plant Pt. 2.** Doorenbos, J.; Gacs, A.; Kiss, Zs. (Iowa State Univ. of Science and Technology, Ames (USA); Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Dec 1987. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703434/JAW.

This report describes the dynamic simulation models of the most important controllers of the secondary circuit of a WWER-440 type nuclear power plant, i.e., the hydraulic turbine controller and the level controls of the condenser hotwell and that of the feedwater tank. Simulation results are also presented. (For dynamic simulation models of the primary circuit of WWER-440 type reactors see Reports KFKI--1983-127 and KFKI--1985-08.) (author) 15 figs.

51134 **(NUREG/CR—2336) Steam generator tube integrity program: Phase II, Final report.** Kurtz, R.J.; Bickford, R.L.; Clark, R.A.; Morris, C.J.; Simonen, F.A.; Wheeler, K.R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 92p. (PNL—4008). NTIS, PC A05/MF A01 - GPO. Order Number TI88015389/JAW.

The Steam Generator Tube Integrity Program (SGTIP) was a three phase program conducted for the US Nuclear Regulatory Commission (NRC) by Pacific Northwest Laboratory (PNL). The first phase involved burst and collapse testing of typical steam generator tubing with machined defects. The second phase of the SGTIP continued the integrity testing work of Phase I, but tube specimens were degraded by chemical means rather than machining methods. The third phase of the program used a removed-from-service steam generator as a test bed for investigating the reliability and effectiveness of in-service nondestructive eddy-current inspection methods and as a source of service degraded tubes for validating the Phase I and Phase II data on tube integrity. This report describes the results of Phase II of the SGTIP. The object of this effort included burst and collapse testing of chemically defected pressurized water reactor (PWR) steam generator tubing to validate empirical equations of remaining tube integrity developed during Phase I. Three types of defect geometries were investigated: stress corrosion cracking (SCC), uniform thinning and elliptical wastage. In addition, a review of the publicly available leak rate data for steam generator tubes with axial and circumferential SCC and a comparison with an analytical leak rate model is presented. Lastly, nondestructive eddy-current (EC) measurements to determine accuracy of defect depth sizing using conventional and alternate standards is described. To supplement the laboratory EC data and obtain an estimate of EC capability to detect and size SCC, a mini-round robin test utilizing several firms that routinely perform in-service inspections was conducted.

51135 **(SNV—3071) Spawn and fry at the Ringhals power plant cooling water intake.** Andersson, J. (National Swedish Environmental Protection Board, Solna). Nov 1985. 22p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754496/JAW.

Scoop netting with fish plankton net was performed in the Ringhals water intake from 1979 to 1984. The investigations were made in winter and spring. A dramatic decline of spawn and fry was established during the period. Particularly affected were Gadus morrhua and Pleuronectes platessa. Other common species like Myoxocephalus scorpius and Pholis gunellus do not show any obvious trends. Neither were any distinct connection between the decline and the natural hydrographic variations established. A possible relation to lack of oxygen in the south eastern part of Kattegat is discussed. The mortality of spawn and fry in passing through the coolant paths is discussed. Information from literature implies an extensive mortality from mechanical damage. (G.B.).

51136 **(ZJE—278) Analysis of brittle fracture conditions in WWER reactor pressure vessel under thermal shock.** Brumovsky, M.; Kuchta, J.; Sik, J.; Stepanek, S. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704166/JAW.

The principal steps are shown of computer assessment of the resistance of the WWER pressure vessels to brittle fracture during transients due to thermal shocks in emergency cooling. A pipe with inner diameter of 20 mm was used to show that a typical WWER-440 pressure vessel is always free from brittle fracture. Calculations were made of temperature and stress fields during emergency cooling. An analysis of brittle fracture conditions was performed in accordance with the INTERATOMEHNERGO, an international corporation for cooperation in the nuclear field, standard. Graphs are presented of the typical temperature distribution along the pressure vessel perimeter, of temperature and stress field distribution through vessel thickness, of stress intensity factor dependence on crack depth for different time intervals during pipe failure, and the time and temperature dependence of the stress intensity factor for different crack depths. (J.B.). 7 figs.

51137 **(EPRI-NP—4574-CCM-Pt.2-Ch.3) ARMP-02 documentation: Part 2, Chapter 3: The EPRI-CELL and CELL-2 CINDER Library: Computer Code Manual.** Eich, W.J.; Kennedy, M.L.; Ozer, O. (Electric Power Research Inst., Palo Alto, CA (USA); Nuclear Associates International Corp., Rockville, MD (USA); Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 48p. NTIS, PC A03 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88016084/JAW.

This paper describes the CINDER libraries generated for use with the EPRI-CELL and CELL-2 codes. In the case of the ENDF/B-V library for the CELL-2 code, this paper includes references containing more complete descriptions of the library-generating processes. 8 refs., 10 figs.

51138 **Microdepletion effects model in the Westinghouse advanced nodal code.** Liu, Y.S.; Green, L.; Meliksetian, A. *Transactions of the American Nuclear Society;* **55**: 344-346(1987). (CONF-8711195---).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A method has been incorporated into the Westinghouse advanced nodal code. (ANC) to account for isotopic variations due to changes in local spectrum conditions from reference conditions. Correction factors are generated at each burnup step by comparison of the actual and reference conditions during the depletion. The method requires very little additional core storage and negligible computation time. Tests of the method by varying local core conditions, e.g., moderator density, soluble boron concentration, core power, far from their reference values showed that it can track the microdepletion-induced reactivity changes with sufficient accuracy, especially in the important burnup range of 10 to 30 GWd/tonne U, where 90% of the reactivity changes are captured.

51139 **Efficient computational method for PWR core dynamics.** Wu, C.D.; Weisman, J. *Transactions of the American Nuclear Society;* **55**: 347-348(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

By combining a modified version of the so-called adiabatic method for reactor dynamic calculations with a simplified flow redistribution scheme, an efficient technique has been developed for predicting three-dimensional core behavior. In the proposed procedure, the neutron flux is described by an average neutron density and a shape function. The proposed approach has been incorporated into the NUTHINC computer program. Comparison of the loss-of-flow results from NUTHINC (with the spatial power distribution fixed) and COBRA III-C showed good agreement between the respective flow and enthalpy distributions. The procedure for core power prediction was verified by showing that NUTHINC results compared well with those from a version of NUTHINC modified so that core power and flux distribution were obtained by direct solution of the full neutron dynamics equations. Preliminary accident analysis results indicate that NUTHINC is more than an order of magnitude faster than methods previously available for three-dimensional dynamic analysis of pressurized water reactors.

51140 **Burnup credit considerations in dry spent-fuel storage licensing.** Roberts, J.P. *Transactions of the American Nuclear Society;* **55**: 391(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Burnup credit has been allowed in reactor basin spent-fuel storage at pressurized water reactors for a number of years. However, such storage occurs under strict administrative, procedural, and design controls. In recent years, dry spent-fuel storage cask vendors have expressed interest in designing cask fuel baskets with allowance for burnup credit. At last year's American Nuclear Society Winter Meeting, an ad hoc session was organized and authorized on burnup credit for dry storage and transportation casks. It has become clear that some utilities are interested in burnup credit for dry storage designs. Given this, the US Nuclear Regulatory Commission (NRC) staff is examining the technical issues involved in allowing burnup credit. Analytical work focused on the development of branch technical positions for determination of burnup credit for dry spent-fuel storage technology designs has begun. Procedural and administrative issues will be examined, based on licensing experience, and will also be the subject of branch technical positions. At an appropriate time, preparation of regulatory guides will be considered.

51141 **Determining burnup credit requirements in spent-fuel storage racks using reactivity equivalencing.** Boyd, W.A. *Transactions of the American Nuclear Society;* **55**: 393-394(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Many utilities are actively seeking to increase the feed enrichments of their fresh fuel assemblies to improve fuel economics. Many utilities are also faced with a shortage of on-site spent-fuel storage locations and are pursuing increased storage capacity through high-density storage racks. It is difficult to accommodate both an increase in storage capacity and maximum enrichment in a spent-fuel rack criticality analysis if the traditional analysis, where the entire storage area is assumed to be filled with the highest enriched fresh fuel, is performed. A method has been developed at Westinghouse that uses the concept of reactivity equivalencing to analyze a spent-fuel rack and to determine the minimum burnup/enrichment requirements that result in acceptable criticality criteria (k/sub eff/ $<$ 0.95). This method is used to demonstrate that the shape of the reactivity equivalence curve is independent of the fuel type, fuel rack, spacing, and fuel rack type.

51142 **Analysis of burnup credit in fuel storage with CASMO.** Napolitano, D.G. *Transactions of the American Nuclear Society;* **55**: 398-399(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Recent trends in nuclear power plant operation have tended toward longer cycles with reload fuel of high ($>$ 3.5 wt% ^{235}U) enrichments. At the same time, the need for greater spent-fuel pool capacity has reduced storage canister spacing to the point where maximum allowable fresh enrichments are lower than those necessary for longer cycles. As a result, burnup credit analysis has been applied to spent-fuel storage rack criticality analysis. This allows the placement, after exposure, of higher fuel enrichments in the spent-fuel racks than would normally be allowed under the assumption of a fresh condition. The CASMO lattice physics code is used to analyze burnup credit on the Maine Yankee spent-fuel storage racks. Unit cell sensitivity analysis of rack criticality to in-core depletion effects and to out-of-core decay is considered. Also, large array criticality analysis is performed to study options for the placement of fresh and burned assemblies.

51143 **Credit for burnup in spent-fuel storage rack design-regulatory perspective.** Brooks, W.L. *Transactions of the American Nuclear Society;* **55**: 400(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The motivation for taking credit for fuel assembly burnup in spent-fuel storage rack design is obvious. Several pressurized water reactor facilities, beginning with the standardized nuclear unit power plant system plants (Callaway and Wolf Creek) have been licensed to install racks that take credit for burnup. Designing racks to take credit for burnup introduces several calculational complexities with respect to criticality that are not present in designing for fresh fuel storage. The criticality analyses are required to be performed with calculational methods and procedures that have been verified by comparison with experiments. Several experiments have been performed with unirradiated fuel that included the major features of fuel racks. However, none has been performed with irradiated fuel. A final aspect of the two-region pool designs is assurance that only assemblies having the required burnup are stored in region 2.

51144 **Reactivity measurements of spent fuel assemblies using a burnup meter.** Goldstein, N.P. *Transactions of the American Nuclear Society;* **55**: 401-402(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Regulatory criticality requirements represent a significant limitation on acceptable configurations for the storage of fuel assemblies in spent-fuel storage racks, the transport of fuel assemblies in multiple assembly casks, and the storage of fuel assemblies in away-from-reactor storage facilities. The capacity of all three situations can be improved by taking credit for fuel burnup (BU), particularly for extended burnup fuels with higher initial enrichments. The determination of burnup may be accomplished administratively, but the extra effort required to preclude the possibility of an error suggests that a direct determination of burnup could offer significant operational advantages. A system to perform these burnup measurements has been designed and built by Westinghouse and demonstrated at the Surry reactor site, all under a US Dept. of Energy contract. The system measures the spontaneous neutron emission produced in burned assemblies from the buildup of the neutron emitters ^{242}Cu and ^{244}Cm. Because multiple captures are involved, the curium isotopes build up as BU^4. This means that uncertainties in the measured neutron counting rate result in much smaller uncertainties in the estimated burnup.

51145 **Development of the spare parts program at Shearon Harris.** Roberts, A.J. *Transactions of the American Nuclear Society;* **55**: 480-481(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Throughout construction, testing, and commercial operation of a nuclear power plant, utilities have a need for spare parts and consumables that must meet a wide range of technical and quality assurance (QA) requirements. The applications for which parts and consumables may be used need to be identified prior to procurement to ensure that the design basis of the plant is not compromised. The spare parts program at Shearon Harris nuclear power plant supported the maintenance department with the proper parts when needed for all but 5% of the maintenance work requests.

51146 **Successful construction schedule reduction for the Tsuruga No. 2 power station.** Uchiyama, M.; Yasui, M.; Pfeifer, B.W. *Transactions of the American Nuclear Society;* **55**: 489-490(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Japan Atomic Power Company Tsuruga Unit No. 2 [four-loop, 1160-MW(electric)] reactor is a Japanese standardized pressurized water reactor unit incorporating advanced engineering technologies and including Japan's first prestressed concrete containment vessel (PCCV). Basic planning for this unit started in February 1977 with some delay experienced due to the Three Mile Island accident. Construction commenced in October 1982 with a schedule of 56 months from first concrete to commercial operation. However, the schedule was shortened by 3.5 months, and the plant started commercial operation on February 17, 1987. This schedule established a world record for a nuclear plant of this size. The following major factors contributed to the overall schedule reduction: (1) early start of the planning and implementation; (2) total project integration; (3) use of plastic detailed design models; (4) early finalization of design; (5) good understanding of PCCV design; (6) use of new construction techniques; (7) enforcement of quality assurance and quality control, responsibilities of the QA/QC organizations were redefined and enforced to review new design and construction procedures. Regular site inspection schedules were established to ensure that quality standards were met and (8) delivery of equipment.

51147 **Design and construction planning for the U.K. standard PWR design.** George, B.V.; Board, J.A. *Transactions of the American Nuclear Society;* **55**: 491-492(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Construction of the U.K.'s first pressurized water reactor, Sizewell B, started in June 1987, and the Central Electricity Generating Board (CEGB) plans to build a series of five or six stations that will replicate the Sizewell B design. The main features of the CEGB strategy are described. The construction planning is started at a very early stage of the project. For Sizewell B some of the key elements are as follows: (1) construction methods and sequences developed for the standardized nuclear unit power plant system (SNUPPS) projects and from Bechtel PWR expertise, modified only where necessary to suit the Sizewell B layout, were adopted. (2) A construction group was involved full-time during the design phase. (3) A 1:75 scale construction model of the principal building of the power block was used to confirm the major building sequences, lifting methods, and positioning of construction access openings and routes. (4) System design clearance occurred sufficiently early to ensure that plant delivery, civil interface, and civil construction design satisfy the construction sequences and timing. (5) Overseas activities were closely observed, in particular the plants at Wolf Creek and Callaway, which were constructed using Bechtel-SNUPPS sequences and methods.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 51211, 51264, 51265, 51268, 51270, 51282, 51285, 51288, 51390

51148 **(DOE/EH—0063) Technical Safety Appraisal of the High Flux Beam Reactor, Brookhaven National Laboratory.** Schleiter, T.G. (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety). Apr 1988. 257p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88013411/JAW.

This summarizes the findings of the Technical Safety Appraisal of the High Flux Beam Reactor (HFBR) facility at the Brookhaven National Laboratory (BNL) which was conducted from June 2-5, and from June 15-25, 1987. No indication was found that a serious accident is likely to occur in the operation of the HFBR; the facility appears to be well maintained and is operated by experienced personnel. The review found overall safety performance acceptable, subject to specific actions noted to assure conformance with DOE requirements or accepted practice, or to further excellence in specific areas already deemed generally good. Neither the general Laboratory population nor the general public are being subjected to unacceptable risks. Programs in 57 of the 112 Performance Objectives considered in the appraisal were found adequate and no concerns were identified. However, many instances were found where a greater level of safety could be attained, and the report contains 95 concerns related to enhancing the safety of operations.

51149 **(Juel—2187) Thermohydraulic investigations on the primary circuit of the HTR for the afterheat removal with natural circulation for the example of the HTR-500.** Holzkamp, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Mar 1988. 153p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754844/JAW.

In this work investigations on the afterheat removal concept of the high temperature pebble bed reactor HTR-500 are made. Besides the afterheat removal the operation of circulators in special loops and coolers the afterheat removal by natural convection is part of the concept. It is therefore of special interest to investigate the assumption, that the cooling gas flows downwards in the pebble bed. The main investigation points are: 1) How is it possible to reach for every possible accident variant the starting conditions for the downwards flow in the pebble bed? 2) Under which conditions an inversion of the flow may appear? 3) Which assumptions have to be fulfilled regarding the reactor so that an afterheat removal with opposite flow can be done without damage? The necessary simulation calculations (to point 2 and 3) are performed with a modified version of the Juelich plant simulation programme THERMIX.

51150 **(Juel-Spez—434) Pebble bed test reactor in peu-a-peu load. Design, operation and safety behaviour by means of computer simulation.** Kranz, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Mar 1988. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754846/JAW.

The presented work deals with a new type of load model for high temperature reactors with spherical fuels: the peu-a-peu load system. Using this load system the reactor core is only filled partially in the beginning of the power operation. But it has to be a critical base core. With proceeding burn-off the reactor is filled up with further fuel elements the way that it stays always just critically. When the reactor is filled up completely with fuel elements, the reactor operation has to be interrupted and the reactor has to be discharged. Afterwards a new cycle can start like the one just described. A reference reactor with 100 MW thermal power is investigated in this work in detail and should make clear the way of function of the load system and the base idea of 'simplicity and safety'. The improvement proposal to use again a part of the fuel elements of a cycle for the next cycle minimizes the higher specific uranium need of a peu-a-peu reactor decisively.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 51248, 51258, 51301, 51312, 51320, 51321

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 51285, 51289, 51290, 51291, 51292, 51293, 51294, 51297, 51864, 52896

51151 **(CEA-CONF—9330) Fast breeder fuel cycle in Europe. Present status and prospects.** Allardice, R.H.; Ebert, K.; Megy, J. and others. (UKAEA Risley Nuclear Power Development Establishment. Process Technology and Safety Directorate; Kernforschungszentrum Karlsruhe (DE)). (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 8p. (CONF-870917—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754775/JAW.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The European experience with the fast reactor fuel cycle covers more than twenty years'work. Considerable experience with fuel fabrication has been accumulated. The existing facilities in Europe, with minor adaptations, are adequate to manufacture all the fuel required for the European fast reactors up to the end of this century. The feasibility of FBR fuel reprocessing has been widely demonstrated in the European facilities at significant scale. Research and development is being undertaken on all aspects of reprocessing activities and the two European pilot plants (Dounreay and Marcoule) are invaluable tools for supporting the design of an industrial scale reprocessing plant.

51152 **(CEA-CONF—9332) Fast breeder reactor fuel reprocessing R and D: technological development for a commercial plant.** Colas, J.; Saudray, D.; Coste, J.A.; Roux, J.P.; Jouan, A. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). 1987. 7p. (CONF-870917—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754777/JAW.

From ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA, USA (13 Sep 1987).

The technological developments undertaken by the CEA are applied to a plant project of a 50 t/y capacity, having to reprocess in particular the SUPERPHENIX 1 reactor fuel. French experience on fast breeder reactor fuel reprocessing is presented, then the 50 t/y capacity plant project and the research and development installations. The R and D programs are described, concerning: head-end operations, solvent extractions, Pu02 conversion and storage, out-of-specification Pu02 redissolution, fission products solution vitrification, conditioning of stainless steel hulls by melting, development of remote operation equipments, study of corrosion and analytical problems.

51153 **(CEA-CONF—9340) Fe - 25Ni - 8/12Cr alloys for FBR core components.** Terlain, A.; Alamo, A.; Alwan, R.; Foucher, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 14p. (In French). (CONF-871022—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754778/JAW.

From International conference on materials for nuclear reactor core applications; Bristol, UK (27 Oct 1987).

In this paper we will report the mechanical properties (tensile and creep) and microstructural evolution during ageing at temperatures between 550 and 750/sup 0/C of four cold-work alloys Fe - 25Ni - 8/12Cr with different Mo, Si, C and Mn contents, Ti content being constant and lower than in precipitation strengthened Fe - Ni base superalloys. These alloys have been developed to avoid the precipitation under irradiation of large amounts of γ' or eta phases which have detrimental effects on the ductility of 25% Nickel alloys. Microstructural evolution during ageing has been characterized by hardness measurements, optical microscopy and X-ray diffraction. The results emphasize that some carbon must be added to the alloys to inhibit γ' formation by trapping a part of T/sup i/ as carbide and that Si content must be controlled to avoid G phase formation. Mechanical properties (tensile and creep) are similar to those of cold-work 15-15 Ti.

51154 **(DOE/EH—0064) Technical Safety Appraisal of the EBR-II, Argonne National Laboratory--West.** Schleiter, T.G. (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety). Apr 1988. 250p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88013410/JAW.

The purpose of the Technical Safety Appraisal Program is to strengthen DOE nuclear operations by encouraging contractors to improve compliance with DOE Orders, to incorporate industry lessons learned, and to promote excellence in safety. Thus, the appraisals address more issues than would be addressed in a strictly compliance-oriented appraisal. The EBR-II is a liquid-metal-cooled fast breeder reactor. It is cooled with molten sodium metal and its chain reactors is perpetuated with very energetic (fast) neutrons. A total of 50 concerns with respect to EBR-II operations were identified. None of these were judged to require prompt or expedited action. No concerns were identified with respect to 54 of the 95 Performance Objectives considered in the appraisal. Programs in the areas of these Performance Objectives were considered adequate. One Noteworthy Practice was identified in the technical area of Maintenance.

51155 (JAERI-M—88-065, pp 135-147) **Benchmark test of JENDL-3T on fast reactors.** Takeda, T.; Takamoto, M.; Takano, H.; Hasegawa, A. (Osaka Univ., Suita (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Benchmark test of JENDL-3T has been performed using many 1-D and a few 2-D benchmark models of fast critical assemblies. The change in core parameters such as k/sub eff/, reaction rate ratio, sodium void worth, Doppler reactivity worth calculated by JENDL-3T from those by JENDL-2 is investigated. We have analyzed the change using sensitivity coefficients calculated from two-dimensional generalized perturbation calculations based on diffusion theory, and investigated the effect of main heavy nuclides.

51156 **(JAERI-M—88-098) High breeding/high burnup fast reactor. Proposal of FP gas purge/tube-in-shell type metallic fuel fast reactor.** Hiraoka, Toru; Sako, Kiyoshi; Takano, Hideki; Osakabe, Masahiro. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 54p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754572/JAW.

Since the most essential characteristics of fast reactors must be fuel breeding as well as economics, a concept of a high breeding/high burnup fast breeding reactor is proposed to persuade very hard neutron spectrum aiming doubling time less than ten years by application of metallic fuel recently developed by ANL, USA in the form to make the most of its advantages. To realize very hard neutron spectrum, a fast reactor core is composed by FP gas purge/tube-in-shell type metallic fuel assemblies. They are cooled by cooling sodium flowing through cooling tubes which penetrate packed hexagonal fuel rods in a shell. The shell is filled with filling sodium which retains the most of fission products other than inert gas. By application of FP gas purge/tube-in shell metallic fuel assembly, volume fraction of fuel is increased and those of sodium and structural material are decreased in comparison with a conventional pinbundle type fast reactor core. Therefore, many advantages are expectable as 1) very high breeding ratio 2) low enrichment fuel 3) better neutron economy 4) unnecessity of excess reactivity for burnup 5) easier FP gas purge 6) removal of limit for high burnup by internal FP gas pressure 7) shorter gas plenum 8) thinner cooling tubes. The breeding ratio of the core is very high upto 1.9 and doubling time is 6 to 7 years. Furthermore, even with low enrichment uranium metallic fuel, fuel breeding can be expected by this concept. Even with refueling generated plutonium to the core to compensate uranium consumption, extra plutonium can be produced for a new plutonium core within ten years. Thus, a fast breeder park can be imagined without any plutonium transport crossing the park boundary if a fast breeder series is initiated by a uranium metallic fuel core.

51157 **(KFK—4403) Investigation of fast reactor fuel pin start up behaviour in the irradiation experiment DUELL II.** Freund, D.; Geithoff, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Apr 1988. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754850/JAW.

The irradiation experiments DUELL-II within the SNR-300 operational Transient Experimental Program deal with the investigation of fresh mixed oxide fuel behaviour at start-up. The irradiation has been caried out in the HFR Petten in four so-called DUELL capsules with two fuel pin samples each. The fuel pins with a total length of 453 mm contained a fuel column of 150 mm length, consisting of high dense (U,Pu)O/sub 2-x/ fuel with an initial porosity of 4%, a Pu-content of 20.9%, and an O/Me ratio of 1.96. The fuel pellet diameter was 6.37 mm, the outer diameter of the SS cladding, material No. 1.4970, was 7.6 mm. The irradiation included four phases, consisting of preconditioning at 85% nominal power (corresponds to 550 W/cm), a following increase to full power, and two following full power periods of 1 and 10 days, respectively. Post irradiation examination showed incomplete fuel restructuring in the first capsules with central void diameters of 800 μm in the hot plane, complete restructuring in the last capsule, leading to central voids of approximately 1 mm diameter. The residual gaps between fuel and clad varied between 25 and 44 μm. The clad inner surface did not show any corrosion attack. The analysis of fuel restructuring has been carried out with the computer code SATURN-S showing good agreement with the PIE results. The analysis led to a series of model improvements, especially for crack volume and relocation modelling.

51158 (KURRI-TR—294, pp 18-24) **Comparison between Monte Carlo method and deterministic method. From the viewpoint of deterministic method.** Takeda, Toshikazu; Arakawa, Yasushi. (Osaka Univ., Suita (Japan). Faculty of Engineering). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

A fast critical assembly consists of a lattice of plates of sodium, plutonium or uranium, resulting in a high inhomogeneity. The inhomogeneity in the lattice should be evaluated carefully to determine the bias factor accurately. Deterministic procedures are generally used for the lattice calculation. To reduce the required calculation time, various one-dimensional lattice models have been developed previously to replace multi-dimensional models. In the present study, calculations are made for a two-dimensional model and results are compared with those obtained with one-dimensional models in terms of the average microscopic cross section of a lattice and diffusion coefficient. Inhomogeneity in a lattice affects the effective cross section and distribution of neutrons in the lattice. The background cross section determined by the method proposed by Tone is used here to calculate the effective cross section, and the neutron distribution is determined by the collision probability method. Several other methods have been proposed to calculate the effective cross section. The present study also applies the continuous energy Monte Carlo method to the calculation. A code based on this method is employed to evaluate several one-dimensional models. (Nogami, K.).

51159 **(TsNIIATOMINFORM-M—2-87) USSR Program for science and engineering support of IAEA safeguards. Problem 5.1. Development of safeguards procedures for a pool-type BN fast reactor.** Ermakov, S.V.; Pushkarev, V.I.; Pykhtin, Yu.D.; Inyutin, E.I.; Tuzov, A.N.; Kochetkov, A.I. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 52p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88703944/JAW.

Results of recommendation development of IAEA control procedures for pool-type BN reactor with integral composition, which was conducted within the framworks of the USSR program for science and engineering support of IAEA safeguards, are presented. Recommendations on IAEA safeguard procedures are given for BN reactor. Analysis of IAEA safeguards application approach development elements such as: nuclear materials management structure, possible nuclear material diversion pathes at NPP, nuclear material inventory verification, application of methods and devices for control, containment and surveilance measures - is conducted on the base of reactor design phylosophy considiration with account of safeguards engineering criterions and of IAEA control procedures experience and practice. Nuclear material control alternative methods and pathways for further improvement of IAEA control procedures effectiveness for NPP with BN reactor are discussed. 17 refs.; 6 figs.; 6 tabs.

51160 **(UJV—7934-T) Methods and programs of thermal hydraulic calculations of fast reactor fuel assemblies.** Mantlik, F.; Schmid, J.; Milbauer, P. et al. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1986. 268p. (In Russian). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88703477/JAW.

Actual printing date 1987.

The methods and computer codes for calculating the velocity and temperature distributions in fast reactor fuel assemblies are described and analyzed. Three levels of thermal hydraulic analysis of fuel element bundles can be distinguished, viz.: analysis of local characteristics (finite element method, finite difference method), subchannel analysis (lumped parameter method), and analysis of characteristics averaged over volumes (porous body model). The possibilities of the existing computer codes and methods are demonstrated and conclusions regarding the future development of methods of and codes for thermal hydraulic analysis of fuel assemblies are presented. (author). 102 figs., 17 tabs., 256 refs.

51161 **Method of adaptive nodes for coarse-node computations.** Tzanos, C.P. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 366-367(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The analysis with the COMMIX program of liquid-metal reactor intermediate heat exchanger (IHX) transients that are characterized by low flows, and especially imbalanced low flows, shows that if a coarse-node structure is used, the predicted temperatures are significantly different than those given by a fine-node structure. If a fine-node structure is used, for problems that involve a large part of the plant, the computation time becomes excessive. In these IHX problems, high-temperature gradients develop along a very short length at one end of the exchanger, and the temperature distribution is practically flat in the remaining length of the unit. For a general-purpose thermal-hydraulic code like COMMIX, a method of general applicability is desirable. This paper presents a method of adaptive node structure that is based on general principles and gives an accurate solution with a few nodes. At this stage it has been applied only to one-dimensional problems. Its application to two and three dimensions is expected to be straightforward.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

51162 **(EGG-M—38487) A multimegawatt space power source radiator design.** Jedruch, J. (Ebasco Services, Inc., New York (USA)). 28 Jan 1988. Contract AC07-76ID01570. 19p. (CONF-880122—17). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015185/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

The multimegawatt space power sources (MMSPS) proposed for deployment in the late 1990s to meet mission burst power requirements, require an increase by four orders of magnitude in the power rating of equipment currently used in space. Prenger and Sullivan (1982) describe various radiator concepts proposed for such applications. They range from the innovative liquid droplet radiator (Mattick and Hertzberg 1981) to the more conventional heat pipe concept (Girrens 1982). The present paper deals with the design of the radiator for one such system, characterized by both high temperature and high pressure. It provides an estimate of the

size, mass, and problems of orbiting such a radiator, based on the assumption that the next generation of heavy launch vehicle with 120-tonne carrying capacity, and 4000-m^3 cargo volume, will be available for putting hardware into orbit.

51163 **(GA-A—19269) TFE verification program: Semiannual report for the period ending April 30, 1988.** (General Atomics Co., San Diego, CA (USA)). Jun 1988. Contract AC03-86SF16298. 210p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88016316/JAW.

The objective of the semiannual progress report is to summarize the technical results obtained during the latest reporting period. The information presented herein will include evaluated test data, design evaluations, the results of analyses and the significance of results. The program objective is to demonstrate the technology readiness of a Thermionic Fuel Element suitable for use as the basic element in a thermionic reactor with electric power output in the 0.5 to 5.0 MW(e) range, and a full-power life of 7 years. 14 refs., 107 figs., 35 tabs.

51164 **(PNL-SA—15433) Rotating solid radiative coolant system for space nuclear reactors.** Apley, W.J.; Babb, A.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 7p. (CONF-880764—4). NTIS, PC A02/MF A01. Order Number DE88016312/JAW.

From 24. AIAA/ASME/SAE/ASEE joint propulsion conference; Boston, MA, USA (11 Jul 1988).

The RING power system described in this paper is proposed as a primary or emergency heat rejection system for advanced space reactor power applications. The system employs a set of four (4) counter-rotating, 90 degree offset, coolant-carrying rings. The rings (segmented, corrugated, finned, thin-walled pipes, filled with liquid lithium) pass through a cavity heat exchanger and reradiate the absorbed heat to the space environment. 25 refs., 6 figs., 3 tabs.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 50862, 51215

51165 **(EPRI-NP—5961) Adaptation of the PARIS technology for measuring wall thinning in ferritic steel components: Final report.** Harrington, T.P. (Electric Power Research Inst., Palo Alto, CA (USA); Sigma Research, Inc., Redmond, WA (USA)). Aug 1988. 117p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015250/JAW.

A new ultrasonic inspection system using a state-of-the-art, flexible transducer array is described. The system, called PARIS, was originally designed for locating and sizing delaminations in carbon epoxy composites. The objective of Project RP1570-22 was to adapt PARIS to test carbon steel components for wall thinning. This report details changes made to the PARISinstrument and the results of tests on laboratory specimens and a 14-inch diameter elbow with extensive wall thinning.

51166 **(NUREG—0040-Vol.12-No.2) Licensee contractor and vendor inspection status report: Quarterly report April 1988--June 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1988. 57p. NTIS, PC A04/MF A01 - GPO. Order Number TI88016489/JAW.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from April 1988 through June 1988. Also included in this issue are the results of certain inspections performed prior to April 1988 that were not included in previous issues of NUREG-0040.

51167 **(NUREG—0304-Vol.13-No.2) Regulatory and technical reports (Abstract Index Journal): Compilation for second quarter 1988, April--June.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Aug 1988. 45p. NTIS, PC A03/MF A01 - GPO. Order Number TI88016371/JAW.

This journal includes all formal reports in the NUREG Series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstracts, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

51168 **(NUREG—0386-Digest-4-Rev.9) United States Nuclear Regulatory Commission staff practice and procedure digest: Commission, Appeal Board and Licensing Board decisions, July 1972--September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of the General Counsel). Jul 1988. 364p. NTIS, PC A16/MF A01 - GPO. Order Number TI88015246/JAW.

This Revision 9 of the fourth edition of the NRC Staff Practice and Procedure Digest contains a digest of a number of Commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period from July 1, 1972 to September 30, 1987 interpreting the NRC's Rules of Practice in 10 CFR Part 2. This Revision 9 replaces in part earlier editions and supplements and includes appropriate changes reflecting the amendments to the Rules of Practice effective through September 30, 1987. The Digest is roughly structured in accordance with the chronological sequence of the nuclear facility licensing process as set forth in Appendix A to 10 CFR Part 2. Those decisions which did not fit into that structure are dealt with in a section on "general matters." Where appropriate, particular decisions are indexed under more than one heading. Some topical headings contain no decisions citations or discussion. It is anticipated that future updates to the Digest will utilize these headings.

51169 **(NUREG—0540-Vol.10-No.5) Title list of documents made publicly available, May 1--31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). Jul 1988. 418p. NTIS, PC A18 - GPO. Order Number TI88014950/JAW.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

2108 Economics

REFER ALSO TO CITATION(S) 51336

51170 **Optimization of design and field activities times.** Bacher, P.; Pierrard, J. *Transactions of the American Nuclear Society;* **55**: 488-489(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

It is well known that systematic efforts to decrease the construction time of a nuclear unit may quickly become expensive because the savings on financial costs are often lower than the extra costs needed to minimize the construction time. On the other hand, the construction time alone cannot be analyzed independently from the design implementation. A significant decrease in this construction time, which appears to be done in Japan, necessitates the beginning and the end of the detailed design well in advance and forbids any major change in the design after the start of construction. By contrast, in the French economic and social context, Electricite de France (EdF) estimates that it has found an optimum solution by undertaking almost in parallel the civil works construction and the

electromechanical design. This optimization leads to an earlier launching of construction activities but a later beginning of design studies and, compared with the other option, results in the following: (1) similar total time for design and construction; (2) lower cost because no special action is taken to speed up construction; and (3) more flexibility for deciding late improvements in design. However, this option, to be successful, requires special attention to be paid to the interfaces between the designer and the construction personnel. In France, the cost of EdF's investments and construction times are among the lower in the world; therefore, EdF can claim it has succeeded in this matter.

51171 **Convoy projects: a case study from Germany.** Gruener, W. *Transactions of the American Nuclear Society;* 55: 490(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Convoy concept was formulated at a time when Kraftwerk Union (KWU) anticipated the start of five to six turnkey nuclear power plant projects within a very short time frame, related to as many customers, sites, and licensing authorities. To counteract the rapidly escalating costs and schedules of projects then under construction, a series of measures were enacted with the purpose of streamlining and optimizing the work procedures both within the company and in relation with the external partners - customers, licensing authorities and their technical advisors, suppliers, and subsuppliers. The organizational framework and the various tools deployed by the turnkey contractor ensured smooth and effective design and construction procedures. The adherence to the original budget and schedule is truly remarkable, encouraging further investigation into the applicability of such methods and procedures for future projects.

51172 **Nuclear construction in six years.** Rasin, W.H.; Abrams, E.B. *Transactions of the American Nuclear Society;* 55: 492-493(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

EPRI's advanced light water reactor (ALWR) project sets forth a challenging list of goals for the design of a next-generation light water reactor. Target values for safety, cost, availability, and construction duration are established. Studies have shown that, if the established values are achieved, an ALWR would be a viable alternative for generating system expansion. The successful construction effort at Catawba and the previous successful experience at St. Lucie are being studied further so that the design and construction requirements can be integrated to create an ALWR that can, with confidence, be constructed in the specified 6-yr period.

51173 **Optimizing the design/construction interface.** Reedy, R.F. *Transactions of the American Nuclear Society;* 55: 494(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The most important documents for improving the design/construction interface are the specifications. Most design/construction specifications are filled with unnecessary boiler plate and contain confusing and contradictory information. Very few good specifications for nuclear power plants exist. As far as most specifications are concerned, the quality would be enhanced a hundredfold if the volume of the specifications could be reduced tenfold. An avenue to usable specifications is to continually review the use of the specification by construction and establish an ongoing, open dialogue between the specification writer and user. To borrow a phrase, we must develop user friendly specifications.

51174 **Toshiba's developments on construction techniques of nuclear power plants.** Hayashi, Y.; Itoh, N. *Transactions of the American Nuclear Society;* 55: 494-495(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Reliable and economic energy supplies are fundamental requirements of energy policies in Japan. To accomplish these needs, nuclear power plants are being increased in Japan. In recent years, construction cost increases and schedule extensions have affected the capital cost of nuclear energy, compared with fossil power plants, due to lower costs of oil and coal. On the other hand, several severe regulations have been applied to nuclear power plant designs. High-quality and cooperative engineering and harmonized design of equipment and parts are strongly required. Therefore, reduced construction costs and scheduling, as well as higher quality and reliability, are the most important items for nuclear industry. Toshiba has developed new construction techniques, as well as design and engineering tools for control and management, that demonstrate the positive results achieved in the shorter construction period of 1100-MW(electric) nuclear power plants. The normal construction period so far is 64 months, whereas the current construction period is 52 months. (New construction techniques are partially applied). In future years, the construction period will be lowered to 48 months. (New construction techniques are fully applied). A construction period is defined as time from the start of rock inspection to the start of commercial operation.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 51096

51175 **(INIS-SU—38/A) Physics and technology of nuclear reactors. Scientific-technical collection.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 111p. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Individual papers are processed separately for the data base. (DLC)

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 52733

51176 **(CTH-RF—59) Time behaviour of the neutron flux at reactivity changes close to criticality.** Sjoestrand, N.G. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics). Feb 1988. 15p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754472/JAW.

In the determination of the control rod positions for which a nuclear power reactor becomes critical, the time behaviour of the neutron flux is usually observed. This time behaviour has been calculated in the point reactor approximation using six groups of delayed neutrons. The results show that, from the shape of the obtained curves, it is difficult to draw any certain conclusions whether the reactor is supercritical or not, if the observation time is as short as 10-30 s. Determination of the doubling time seems to be a good help in deciding when to decrease the steps in the control rod movements and increase the observation time in order to avoid unintentional criticality.

51177 **(INIS-XN—123) State of the art on reactor noise analysis.** Bernard, P.; Fry, D.; Stegemann, D.; Van Dam, H. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Oak Ridge National Lab. TN, (USA); Technische, Univ. Hannover, (Germany, F.R.); Interuniversitair Reactor Inst. Delft. (Netherlands)). (Nuclear Energy Agency, 75 - Paris (France)). 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703284/JAW.

This report is the result of the work of a task force sponsored by the NEA Committee on Reactor Physics (NEACRP) and is divided into six chapters: 1. Loose-Parts Detection and Acoustic Monitoring, 2. Thermal Hydraulics Surveillance, 3. Flow Measurements, 4. Vibration Monitoring, 5. Surveillance Systems and Evaluation Methods, and 6. System Dynamic Analysis. Each chapter summarizes the current situation in noise analysis techniques with emphasis on the following aspects: . physical quantities considered, . possible anomalies involved, . sensors used for the detection, and . conditions of applications. The remainder of each chapter discusses future trends and recommendations.

51178 **(ITEF—27(1987)) Reactor with perpendicular lattices.** Galanin, A.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703290/JAW.

The theory of an infinitely large reactor with two mutually perpendicular uniform lattices comprising small blocks is developed in diffusion approximation. Ratios of neutron fluxes on the surfaces of blocks of the first and the second lattices and the value of neutron flux wave amplitude along the blocks are obtained. Using graphic interpretation of the results obtained for point blocks the formulae are generalized for lattices with blocks of the final radius. 2 refs.

51179 (JAERI-M—88-065, pp 460-466) **Critical experiment and analysis on thorium test assembly in UTR-KINKI. A note on nuclear data library of thorium.** Miki, Ryota; Itoh, Tetsuo. (Kinki Univ., Higashi-Osaka, Osaka (Japan). Atomic Energy Research Inst.). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Integral critical experiment on thorium test assemblies which are installed at the center of internal graphite reflector of UTR-KINKI, Kinki University Reactor, has been performed. The experiment includes (1) Measurement of the reactivity effect of the space between thorium metal plates in the test assemblies and (2) Measurement of detailed relative vertical neutron flux distribution in the test assemblies. Analytic calculations by JEARI Thermal Reactor Standard Code System for Reactor Design and Analysis (SRAC Code System) on the reactivity effect of thorium test assembly and on the neutron flux distribution were also performed. The measured values agree fairly well with the calculated results when JENDL-3T data file was used. The cross section data of thorium in JENDL-2 library give somewhat lower C/E values on reactivity effect.

51180 (KURRI-TR—294, pp 10-17) **Comparison of Monte Carlo method and deterministic method for neutron transport calculation. From the viewpoint of Monte Carlo method.** Mori, Takamasa; Nakagawa, Masayuki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

The report outlines major features of the Monte Carlo method by citing various applications of the method and techniques used for Monte Carlo codes. Major areas of its application include analysis of measurements on fast critical assemblies, nuclear fusion reactor neutronics analysis, criticality safety analysis, evaluation by VIM code, and calculation for shielding. Major techniques used for Monte Carlo codes include the random walk method, geometric expression method (combinatorial geometry, 1, 2, 4-th degree surface and lattice geometry), nuclear data expression, evaluation method (track length, collision, analog (absorption), surface crossing, point), and dispersion reduction (Russian roulette, splitting, exponential transform, importance sampling, corrected sampling). Major features of the Monte Carlo method are as follows: 1) neutron source distribution and systems of complex geometry can be simulated accurately, 2) physical quantities such as neutron flux in a place, on a surface or at a point can be evaluated, and 3) calculation requires less time. (Nogami, K.).

51181 **(PSI—10) Bispectrum estimation using overlapped segments.** Pineyro, J.; Behringer, K. (Paul Scherrer Institut, Labor fuer Reaktorphysik und Systemtechnik, Wuerenlingen (Switzerland)). (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland). Lab. fuer Reaktorphysik und Systemtechnik). Jun 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704064/JAW.

Criteria have been elaborated for the application of the Welch method to the bispectrum estimation. The development of a combined procedure is attempted for the simultaneous estimation of the power spectral density and the bispectrum. (author) 26 refs., 5 figs., 1 tab.

51182 **(UJV—8191-R-A) Testing of three-dimensional neutron kinetics code HEXDYN3D in experiments on LR-0 reactor.** Grundmann, U.; Cermak, I.; Hadek, J. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Nov 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703946/JAW.

Kinetic measurements on the LR-0 reactor consisting of similar subassemblies as power reactor WWER-1000 are used for the testing of three-dimensional neutron kinetics code HEXDYN3D. Small differences between the measured and the calculated reactivity effects are used for adjusting the multiplication factors of subassemblies with inserted clusters. The obtained results show that the space-time effects of neutron flux behaviour are very well described by the code. (author). 20 figs., 10 refs.

51183 **Neutron slowing down and transport in an infinite medium - I: generalized age theory and its range of validity.** Cacuci, D.G. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 336-337(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

There has been renewed interest recently in analytical investigations of long-standing problems whose complete solutions have eluded us thus far. One such problem is the slowing down and transport of neutrons by purely elastic scattering in an infinite homogeneous medium with cross section independent of energy. The complete analytical expression for Psi (x, μ, u) is still unknown to date. Research so far has only produced approximate solutions for the limiting cases of (large u)/(small x) and (very small u)/(very large x). Thus, for energies very small compared to the source energy (i.e., at large lethargy), the neutron's track in phase space can be described by a random walk with many steps, and the law of large numbers may be used to describe the energy and spatial distribution of the neutrons, at least not too far from the source. The resultant predictions, known as age theory, have been widely used in practical applications. The purpose of this work is to reexamine the behavior of Psi (x, μ, u) in the region of the (x-u) phase space that includes age theory. The new results obtained in the course of this reexamination are (a) an expression for Psi (x, μ, u) that considerably generalizes age theory, (b) the theoretical range of validity for this expression, as a function of the medium's atomic mass, and (c) comparisons with the results known prior to this work; these comparisons help establish the ranges of validity of these previous results.

51184 **Multimode kinetics structure analysis: a new integration technique of multimode kinetics equations.** Edgue, E.; Yarman, T. (Tech Univ. of Istanbul (Turkey)). *Transactions of the American Nuclear Society;* **55**: 338-340(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Multimode kinetics equations (MMKEs) can be formed starting with the usual multigroup diffusion equations. A two-mode synthesis, the simplest approach that takes care of the space-dependency change throughout a transient, is considered to be the main tool used in the present work. To display the goal and keep the rest as simple as possible, the authors consider two basic transients, namely, a sudden insertion of a central control rod in a one-region homogeneous cylindrical and originally critical system, and a sudden ejection of a central control rod from a bare cylindrical and originally critical system, thus composed of two concentric homogeneous regions. In both cases, a rod follower concept is adopted.

51185 **Finite difference method for treating the Doppler broadening of neutron cross sections.** Leal, L.C.; Hwang, R.N. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 340-342(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

It is well known that Doppler-broadened cross sections satisfy the usual heat equation of the form $\delta^2F/\delta x^2 = \delta F/\delta t$, where x is the variable in either energy or momentum space and t is proportional to the physical temperature in question. Given the initial condition F(x,O) for -infinity $<$ x $<$ infinite and the boundary condition F(infinity,t) = F (infinity,O); F(-infinity,t) = F(-infinity,O), the function can be calculated by use of finite difference methods. One inherent problem in using such an approach is that excessive numbers of mesh points in both x and t are generally required near the peaks of the resonances where the maxima of the function and its higher order derivatives occur. The problem is inevitable where the explicit or implicit scheme is used. An explicit finite difference scheme that is believed to be more suitable than the implicit method in treating the Doppler broadening of the resonance cross sections is described. Pertinent issues and inherent limitations of the method are also addressed.

51186 **Advanced nodal neutron diffusion method with space-dependent cross sections: ILLICO-VX.** Rajic, H.L.; Ougouag, A.M. (Univ. of Illinois, Urbana (USA)). *Transactions of the American Nuclear Society;* **55**: 342-343(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Advanced transverse integrated nodal methods for neutron diffusion developed since the 1970s require that node- or assembly-homogenized cross sections be known. The underlying structural heterogeneity can be accurately accounted for in homogenization procedures by the use of heterogeneity or discontinuity factors. Other (milder) types of heterogeneity, burnup-induced or due to thermal-hydraulic feedback, can be resolved by explicitly accounting for the spatial variations of material properties. This can be done during the nodal computations via nonlinear iterations. The new method has been implemented in the code ILLICO-VX (ILLICO variable cross-section method). Numerous numerical tests were performed. As expected, the convergence rate of ILLICO-VX is lower than that of ILLICO, requiring $\sim$ 30% more outer iterations per k/sub eff/ computation. The methodology has also been implemented as the NOMAD-VX option of the NOMAD, multicycle, multigroup, two- and three-dimensional nodal diffusion depletion code. The burnup-induced heterogeneities (space dependence of cross sections) are calculated during the burnup steps.

51187 **Evaluation of mini super computers for nuclear design applications.** Altomare, S.; Baradari, F. *Transactions of the American Nuclear Society;* **55**: 346-347(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The evolution of the mini super computers will force changes from the current environment of performing nuclear design calculations on mainframe computers (such as a CRAY) to mini super computers. This change will come about for a number of reasons. First, the mini super computers currently available in the marketplace offer the power and speed comparable to mainframes and can provide the capability to support highly computer intensive calculations. Second, the equipment is physically smaller and can easily be installed and operated without extensive investments in facilities and operations support. Third, the computer capacity can be acquired with as much needed memory, disk, and tape capacity as may be needed. Another reasons is that the performance/cost ratio has increased drastically as hardware costs have decreased. A study was conducted at the Westinghouse Commercial Nuclear Fuel Division (CNFD) to evaluate the mini super computers for use in nuclear core design. As a result of this evaluation, Westinghouse CNFD is offering a combined hardware/software technology transfer package for core design. This package provides the utility designer with a totally dedicated mini super computer comparable in speed to the CRAY 1S with sufficient capacity for a sizable design group to perform the engineering activities related to nuclear core design and operations support. This also assures the utility of being totally compatible with the CNFD design codes, thus assuring total update compatibility.

51188 **Linear characteristic method in XYZ geometry.** Childs, R.L.; Rhoades, W.A. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 352-354(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The linear characteristic (LC) method has been previously investigated in XY geometry. In this paper, the implementation of the LC method in the three-dimensional discrete ordinates code TORT is described, and a comparison is made between LC and the other methods used in TORT, namely, the weighted difference and linear nodal (LN) methods.

51189 **Monte Carlo response matrix method.** Wan, T.C.; Martin, W.R. (Univ. of Michigan, Ann Arbor (USA)). *Transactions of the American Nuclear Society;* **55**: 359-361(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The response matrix method (RMM) has been used in nuclear reactor analysis for many years. It consists of two distinct calculational steps - the local calculation to compute the response matrices and the global calculation to compute the global partial current and flux distributions. The Monte Carlo method (MCM) has been used previously to compute the response matrices in the local calculation but has not been utilized to perform the global calculation. In this work, a new method, the Monte Carlo response matrix method (MCRMM), implements the MCM for both the local and global calculations. The MCRMM has been developed and tested. It retains the well-known advantage of the RMM to eliminate unneeded calculations at the lower level. That is, once the response matrices (pdf's and track-length tables in the MCRMM) are generated from the local calculations, one may solve problems in any combination of cells without redoing the local calculations. In addition, a fast discrete sampling method has been applied in the global calculation. Finally, a Dirichlet distribution sampler has been implemented in order to do a sensitivity analysis to evaluate the uncertainties due to the generated response pdf's.

51190 **Factorized implicit solution technique for calculation of flow in reactor components.** Sargis, D.A.; Chilukuri, R.; Stuhmiller, J.H. *Transactions of the American Nuclear Society;* **55**: 371-372(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A factorized implicit finite difference scheme (FIST) for solving the three-dimensional, time-dependent Navier-Stokes equations is presented in this paper. The overall solution strategy and treatment of interequation coupling is similar to the well-known implicit continuous fluid Eulerian (ICE) and SMAC procedures. However, several features of the implicit FIST algorithm enable use of large time steps in contrast to the ICE scheme. The FIST method of integrating the momentum equations is best described as an extension of the Peaceman-Rachford alternating direction implicit (ADI) scheme. The Peaceman-Rachford ADI scheme was developed for the unsteady heat (diffusion) equation. The innovative feature of the FIST algorithm lies in implicit treatment of both advection and diffusion terms. The FIST scheme is an efficient of integrating the unsteady Navier-Stokes equations. The advantage of the FIST algorithm over fully implicit schemes is that FIST requires simultaneous solution of only simple-line tridiagonal matrix equations. Fully implicit algorithms, on the other hand, generally require solution of a large system of coupled algebraic equations at each time step.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 51165, 51278, 52028

51191 (CEA-CONF—9353) Non destructive testings. Contre, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 89p. (In French). (CONF-8712112—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754786/JAW.

From 6. Pechiney conference on technology; Joinville, France (1 Dec 1987).

In this paper the author after having indicated the methods used in nondestructive testing presents 4 of these methods - X-ray and gamma radiography - ultrasonic testing - eddy current - acoustic emission.

51192 (EPRI-CS/NP—5878-SR) EPRI power plant valves symposium: Proceedings. Lansing, N.F. (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1988. 255p. (CONF-8708263—). Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88012774/JAW.

From EPRI Power Plant valves symposium; Kansas City, MO, USA (25 Aug 1987).

Power plant valves have a significant effect on the availability of generating units and on maintenance costs. This is an opinion held by many in the utility industry and largely rests on general impressions rather than quantitative studies. There is a general lack of statistics regarding those specific effects, and thus an inability to identify specific types of valve-related problems that should be addressed. The NERC/Generating Availability Data Systems (GADS) data compiled from utility reports, for example, provide little insight on valve-related problems. Typically, any effects from valve problems are consolidated under the category of the related plant equipment. Additional information is needed, therefore, to clarify and quantify the effects of valves and thus provide guidance with respect to the need for R & D on various types of valves. This symposium was sponsored by EPRI to address this general need to improve the understanding of power plant problems related to valves and their effects on plant availability. The meeting had three general objectives: to define the extent of utility interest in valves and the specific problems utilities have with them; to help EPRI assess the types of R & D on valves that would benefit the utility industry; and to provide a forum at which utilities, manufacturers, and others could exchange information and describe the best available technology for power plant valves.

51193 (EPRI-NP—5951) Reliability of magnetic particle inspection performed through coatings: Final report. (Electric Power Research Inst., Palo Alto, CA (USA); Sea Test Services, Merritt Island, FL (USA)). Jul 1988. 203p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014885/JAW.

The magnetic particle examination (MT) technique can reliably examine containment welds without removing their protective coatings. This study has investigated a variety of MT methods used in the oil and gas industry for their suitability for nuclear plant applications. 102 figs.

51194 (EPRI-NP—5978) Verification and validation of expert systems for nuclear power plant applications: Final report. Kirk, D.B.; Murray, A.E. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., McLean, VA (USA)). Aug 1988. 113p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016200/JAW.

This report describes a methodology for the Verification and Validation (V&V) of expert systems developed for nuclear power applications. Verification pertains to the internal correctness of the system and addresses the task of eliminating errors made by the builders in translating their original plan into a detailed design and coding it. Validation, on the other hand, refers to external correctness which is manifest in correct or desired output when the system is operating in a realistic environment. The field of expert system development is still new, with few expert systems in operational use, particularly in critical applications such as nuclear power where a thorough V&V program is requisite. Therefore, techniques for verifying and validating these systems are even newer, and still an area of much research and development. Fortunately, significant progress has been made in expert system V&V. This progress, when combined with a careful assessment of the possible contributions from conventional software V&V, allows a methodology for the V&V of expert systems for nuclear power applications to be developed.

51195 (INIS-SU—38/A, pp 13-19) Computer shaping of in-pile flow velocity field. Leonchuk, M.P.; Sivak, Z.V.; Shvetsov, Yu.E. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

A simple numerical algorithm permitting to find the law of radial variation of porosity of the shaping lattice placed in the inlet device of the reactor, at which the assigned shape of in-pile flow velocity field in the reactor core is provided, is plotted on the basis of numerical calculation of two-dimensional flow velocity fields in an anisotropic porous body. The numerical method for solution of hydrodynamic equations was tested by comparison with experimental data obtained when studying the process of mixing in the hydrodynamic model of the upper mixing chamber of the BN-600 reactor. Opportunities of the suggested algorithm are shown on the example of solving the problems of hydraulic shaping. Its operability at rather complex vertex flow picture in the inlet device is exhibited. 8 refs.; 5 figs.

51196 (INIS-SU—38/A, pp 64-66) Calculation of thermal parameters by the variant-statistic method. Bushinskij, A.V.; Zhabotinskij, E.E.; Il'ichev, A.V.; Chernyavskij, Yu.V. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

The variant-statistic method of calculation consisting in presentation of the initial data as random values, calculation of many thousands of variants using the monte Carlo method and plotting the fields of output parameters of objects showing the probability of hitting any region of the field is presented. The method was tested when calculating the probability of determining thermohydraulic parameters within the assigned limits for stationary operating modes of NPP units and for solution of other direct problems. An algorithm for solution of an inverse problem of radial distribution of tolerances for functional parameters of units at limitations for output parameters of the object in two representations: with restriction of tolerances and their shift is suggested. An example of correction of tolerances for parameters of the heater is given. 2 refs.; 2 figs.; 1 tab.

51197 (INIS-SU—38/A, pp 88-94) Technique to determine stability of natural convection circuits. Treshchev, G.G.; Urusov, G.L.; Sukhov, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

The results of systematic experimental and calculational-analytical study of boundaries of thermohydraulic instability of non-equilibrium steam-water flow in circuits with natural convection in a wide range of regime parameters are presented. The effect of pressure, specific heat load, underheating of water at the outlet to the steam generating channel and rigidity of pressurizer on position of the boundary of the instability range is shown. 2 refs.

51198 (KURRI-TR—293, pp 76-81) Sealing performance of various gaskets. Yamamoto, Hiroshi; Araki, Yasusuke; Shibata, Toshikazu. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780146/JAW. (CONF-8608229—).

From 7. symposium on the development of advanced technology for scientific research; Kumatori, Japan (19 Aug 1986).

In the high dose zone in nuclear reactors, the gaskets used for the flanges jointing different metals are subjected to the radiation damage and the repeated displacement between the flanges due to the difference of thermal expansion. But as for the gaskets withstanding both, it is the actual state that the manufacturers have little experience and result. However, in the part jointing the reflector vessel and the core vessel and in the experiment holes of the Kyoto University high neutron flux reactor (KUHFR) at the planning stage, it was calculated that the lateral deviation of about 0.6 mm arises in the gasket part at temperature difference of 43 deg C under the above condition. The prevention of the leak of primary coolant and heavy water is very important for the safety management of nuclear reactors, and it is necessary to examine beforehand on sealing method. In this study, by giving repeated displacement to gaskets, the test on sealing performance was carried out, and the results are reported. Three kinds of gaskets, that is, Balck Tight, Helicoflex and solid aluminum gasket, were selected, and the statical test and the dynamic test were carried out. The tightening load dropped largely at the initial period in all the gaskets. The Black Tight was most stable, and is suitable to the use for the KUHFR. (Kako, I.).

51199 **(NUREG/CR—5096) Evaluation of seals for mechanical penetrations of containment buildings.** Brinson, D.A.; Graves, G.H. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA); ERC International, Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 135p. (SAND—88-7016). NTIS, PC A07 - GPO. Order Number TI88015603/JAW.

This report describes tests of elastomeric seals that are used in the mechanical penetrations of nuclear power plant containments. These tests assessed the effects of thermal aging, radiation and thermal aging, sealing surface separation, and squeeze on the performance of several gasket designs: O-ring, gum drop, double dog ear, and tongue and groove. Both ethylene propylene rubber and silicone rubber gaskets were tested. The environment for testing enveloped a hypothetical severe seals is quantified in terms of the leakage onset point on the time-temperature curve.

51200 **(SAND—88-2334C) The solubility of gases in molten reactor core materials.** Powers, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 16p. (CONF-8806143—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015695/JAW.

From 2. nuclear reactor severe accident chemistry symposium; Toronto, Canada (5 Jun 1988).

Estimates of the solubilities of hydrogen and nitrogen in molten iron alloys based on empirical data are presented. Estimates of the physical solubilities of hydrogen, steam and nitrogen in molten uranium dioxide, molten zirconium dioxide and and in molten aluminum oxide based on a model involving holes in the liquid are presented. It is speculated that chemical interactions may enhance the solubility of steam in molten uranium dioxide. It is shown that effervescence accompanying isobaric quenching of the melts could cause foaming of the melt. Isothermal depressurization especially of metallic melts could produce more vigorous disruption of the melt. 26 refs., 4 figs.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 51200, 51272

51201 **(DOE/ID/12651—2-Vol.3) Fuel Rod Consolidation Project: Phase 2, Final report: Volume 3, Electrical, mechanical, structural and Remotec Corp. drawings.** (NUS Corp., Gaithersburg, MD (USA)). Dec 1987. Contract AC07-86ID12651. 894p. NTIS, PC A99/MF A01. Order Number TI88004221/JAW.

51202 **(ITEF—132(1987)) Algorithm and program for thermal-hydraulic calculation of gas cooled reactor fuel assembly. TABOR program.** Lebedev, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703309/JAW.

Consideration is being given to TABOR program (FORTRAN, BESM-6 computer), designated for stationary thermal-hydraulic calculation of gas cooled fuel assembly (FA) with cylindrical jacket and random arrangement of homogeneous and heterogeneous fuel elements. Cell method is used for solution of the problem. FA flow section is divided into elementary cells with coolant characteristics considered to be constant within their limits. System of conservation equations of mass, pulse and energy is written for each cell. Integration of this system is conducted by Euler method with preliminary cell equalization of longitudinal pressure gradients and with successive FA section pressure averaging. The time of FA calculation equals 7-20 min. The program is applied in calculations of feasibility studies. 8 refs.; 1 fig.

51203 **(NUREG/CR—5119) Metallographic examination of the severe fuel damage scoping test (SFD-ST) fuel rod bundle cross sections.** Hofmann, P. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis; EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1988. Contract AC07-76ID01570. 121p. (EGG—2537). NTIS, PC A06/MF A01 - GPO. Order Number TI88015248/JAW.

A series of severe fuel damage (SFD) tests was performed in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory (INEL) to obtain data necessary to understand: (1) fission product release, deposition, and transport; (2) hydrogen release; and (3) fuel behavior and coolability during severe fuel damage accidents. This report presents the results from the metallographic posttest examination of the fuel rod bundle cross sections of the first experiment in the SFD series, the Scoping Test (SFD-ST). The metallographic appearance of the zircaloy cladding, solidified melt, UO_2 fuel, Inconel spacer grids, and other instrumentation and structural components is discussed. The observed structures are compared to those documented in well defined, out-of-pile, separate-effects reference experiments. The chemical interactions that take place at high temperatures between the fuel bundle components are described; and estimates of peak test temperatures are made, based only on metallography since scanning electron microscopy results were not available.

2204 Control Systems

REFER ALSO TO CITATION(S) 51219, 51972, 52911

51204 **(CONF-880899—2) Hierarchical control of a nuclear reactor using uncertain dynamics techniques.** Rovere, L.A.; Otaduy, P.J.; Brittain, C.R.; Perez, R.B. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina); Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016345/JAW.

From IEEE international symposium on intelligent control; Arlington, VA, USA (24 Aug 1988).

Recent advances in the nonlinear optimal control area are opening new possibilities towards its implementation in process control. Algorithms for multivariate control, hierarchical decomposition, parameter tracking, model uncertainties actuator saturation effects and physical limits to state variables can be implemented on the basis of a consistent mathematical formulation. In this paper, good agreement is shown between a centralized and a hierarchical implementation of a controller for a hypothetical nuclear power plant subject to multiple demands. The performance of the hierarchical distributed system in the presence of localized subsystem failures is analyzed. 4 refs., 13 figs.

51205 **(EPRI-NP—5962) Evaluation of NASA's Launch Processing System for nuclear power applications: Final report.** Ipakchi, A.; Peng, C.M.; Chen, H.T.; Khadem, M. (Electric Power Research Inst., Palo Alto, CA (USA); Systems Control, Inc., Palo Alto, CA (USA)). Aug 1988. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88014916/JAW.

The Space Shuttle Launch Processing System (LPS) automation technology is developed by NASA for the support of the shuttle launch control process. The LPS is based on a software package composed of a high-level real-time programming language and the associated control logic and the user interface facilities. The primary mission of the LPS is to prevent hazardous manual intervention and to allow automatic reaction to out of tolerance events. It also supports interactive and automated control techniques and provides graphical displays for monitoring and control tasks. The LPS programming language includes rule-based capabilities to monitor data, to initiate control actions, and to override operator actions which are inconsistent with the rule set. The NASA's Space Shuttle Launch Processing System has been demonstrated to Nuclear Regulatory Commission (NRC) for an application to nuclear power plant. Using the TMI accident as a reference, the demonstration system shows how the LPS technology can be employed to handle some of the operational deficiencies encountered during the accident. It illustrates the sequence of events including the manual actions, and shows places where the LPS would have intervened to prevent the accident. The purpose of this report is to evaluate this demonstration system both in terms of its applicability to the nuclear industry, and the technology used. Specific recommendations for consideration by EPRI are made. 8 refs., 9 figs.

51206 **(INIS-mf—11811) Qualification of nuclear power plant operations personnel. Abstracts.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1988. 66p. (CONF-8804187—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754659/JAW.

From IAEA interregional training course on qualification of nuclear power plant operations personnel; Karlsruhe, F.R. Germany (11 Apr 1988).

The report contains the abstracts of lectures and names and addresses of lecturers and participants.

51207 **(INIS-mf—11812) Instrumentation and control of nuclear power plants. Abstracts.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1987. 52p. (CONF-8710369—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754660/JAW.

From IAEA interregional training course on instrumentation and control of nuclear power plants; Karlsruhe, F.R. Germany (12 Oct 1987).

The report contains the abstracts of lectures and names and addresses of lecturers and participants.

51208 (KURRI-TR—293, pp 1-10) **Rod calibration of the KUR.** Ikegawa, Ryusho. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780146/JAW. (CONF-8608229—).

From 7. symposium on the development of advanced technology for scientific research; Kumatori, Japan (19 Aug 1986).

The calibration of control rods in the KUR at present has become important for the management rather than for experiment. For instance, referring to these data, the plan for changing the core arrangement can be established. In this paper, the method and techniques are discussed, instead of reactor physics. The methods usually taken at the time of every inspection are period method and comparison method. These methods are briefly explained. Till around 1975, the data processing was carried out manually, but it is very troulesome to solve an inhour equation, therefore, it was determined by referring to the table being solved beforehand with a computer for every 1 sec of the reactor period. From 1976 to 1978, semiautomatic data processing was carried out by using an OKITAC-4300 minicomputer. At present, a recently adopted minicomputer of Data General is used, and a plotter is connected to it to draw figures. The procedure generally carried out at present is explained. The differential reactivity curve for control rods results theoretically in the curve of square of cosine, but recently it has become that the peak seems to be in a lower position. In order to confirm this tendency, 38 control rod calibration experiments were reviewed. As this tendency was confirmed, the control rods were renewed. The problems for the future are pointed out. (Kako, I.).

51209 (KURRI-TR—293, pp 82-85) **Kyoto University Reactor diagnostic system.** Kimura, Yasuhiro; Ikegawa, Ryusho; Ishihara, Shinji; Nakamura, Hiroshi; Tsujimoto, Hitomi; Kozuka, Toshihiko; Fujine, Shigenori; Nishihara, Hideaki; Shibata, Toshikazu. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780146/JAW. (CONF-8608229—).

From 7. symposium on the development of advanced technology for scientific research; Kumatori, Japan (19 Aug 1986).

For the safety of a nuclear reactor, it is very important that the operators and manager make exact judgement about the various conditions of the nuclear reactor occurring at times. The research is advanced for the purpose of adopting a computer system for the research reactor of Kyoto University (KUR), offering effective information to operators and maintenance workers, making the advice for exactly judging the conditions of the reactor by sufficiently grasping them, consequently, developing the system for increasing the safety of the reactor. For the development of this system, also technical officials took part positively and cooperated in the research and development based on the experience of the maintenance and operation of the research reactor carried out daily. The system comprises the data acquisition part, data base, abnormality diagnostic part, man-machine interface part, and individual dealing part. The abnormality of the reactor is identified by the judgement of operators by referring to the data memorized in the data base, then, the reactor is operated. The constitution of the computer system used is shown. The CPU is a minicomputer ECLIPSE S-140, and the main memory is 512 kB. The auxiliary memories are a fixed disk equipment of 73 MB, two floppy disk equipments and a magnetic tape equipment. Respective subsystems are explained. (Kako, I.).

51210 **Artificial intelligence applications to nuclear reactor diagnostics.** Lee, J.C.; Hassberger, J.A.; Wehe, D.K. (Univ. of Michigan, Ann Arbor (USA)). *Transactions of the American Nuclear Society;* **55**: 428-429(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The authors research into applications of artificial intelligence to nuclear reactor diagnostics involves three main areas. In the first area, the authors combine reactor simulation models and expert systems to diagnose the state of the plant. The second area examines ways in which the rule or knowledge base of an intelligent controller can be generated systematically from either fault trees or acquired plant data. Third, efforts are described to develop the capabilities to validate these techniques in a realistic reactor setting. The techniques are applicable to all reactor types, including fast reactors.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 51254, 51255, 51262, 51264, 51283, 51410, 51410, 52109, 52110, 52111, 52112, 52113, 52114, 52115, 52116, 52117, 52140, 52141, 52178, 52179, 52180, 52182

51211 (CONF-760202—, pp 701-704) **Tritium in tropospheric water vapor.** Johnson, J.E.; Berven, B.A.; Bard, S.T. (Colorado State Univ., Fort Collins, (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Colorado State University has provided the entire pre-operational radiation surveillance of the Fort St. Vrain high temperature, gas cooled reactor. Background radiation and radionuclide measurements indicate the pattern of world wide fallout observed

in this locale since 1962. Of particular interest has been observation of tritium in tropospheric water vapor. The water vapor is collected on silica gel. Peak values observed here follow foreign nations weapons testing. Intersite variation is great and apparently is dependent on micrometeorlogical variations. The value of continuous water vapor sampling is apparent when this variation is considered in calculating minimum detectable reactor releases.

51212 **(CONF-880903—20) A generic hazardous waste management training program.** Carter, R.J.; Karnofsky, B. (Oak Ridge National Lab., TN (USA); Environmental Resources Center, Fayetteville, NC (USA)). 1988. Contract AC05-84OR21400. 6p. (CONF-880903—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015280/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

The main purpose of this training program element is to familiarize personnel involved in hazardous waste management with the goals of RCRA and how they are to be achieved. These goals include: to protect health and the environment; to conserve valuable material and energy resources; to prohibit future open dumping on the land; to assure that hazardous waste management practices are conducted in a manner which protects human health and the environment; to insure that hazardous waste is properly managed thereby reducing the need for corrective actions in the future; to establish a national policy to reduce or eliminate the generation of hazardous waste, wherever feasible. Another objective of this progam element is to present a brief overview of the RCRA regulations and how they are implemented/enforced by the Environmental Protection Agency (EPA) and each of the fifty states. This element also discusses where the RCRA regulations are published and how they are updated. In addition it details who is responsible for compliance with the regulations. Finally, this part of the training program provides an overview of the activities and materials that are regulated. 1 ref.

51213 **(EGG-TMI—8058) TMI-2 core bore gamma ray spectroscopy measurements.** McIsaac, C.V.; Akers, D.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Jun 1988. Contract AC07-76ID01570. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88015146/JAW.

Gamma spectroscopy measurements were performed on TMI-2 core samples to evaluate the distribution of gamma-ray-emitting radionuclides, structural materials (^{60}Co), and uranium fuel (^{144}Ce) in the lower portion of the reactor core. A core boring machines, similar in design to the boring machines employed to extract geological core samples, was used during July and August, 1986, to drill through the entire height of the damaged TMI-2 reactor core at ten different locations. At nine of these locations, core samples measuring 0.064 m in diameter by about 1.8 m long were extracted from the reactor core. The core bore samples contained sections of intact fuel rods, crust layers surrounding the central core region, and previously molten ceramic material. This report presents the results of the high-resolution gamma ray spectroscopy measurements that were performed on the nine core bore samples. The results indicate that undamaged regions of the fuel rod sections retained their original fission product inventories. Of the amount of ^{137}Cs originally retained in the fuel that was assimilated into the previously molten ceramic material, less than 2% was retained in the ceramic material. The results also show that the concentrations of ^{106}Ru, ^{125}Sb, and ^{60}Co in the ceramic material are as much as a factor of ten higher than their corresponding concentrations in the intact fuel rods.

51214 **(EPRI-NP—5969) Problem assessment of discrete radioactive particles: Final report.** James, D.W. (Electric Power Research Inst., Palo Alto, CA (USA); Vance and Associates, Ruidoso, NM (USA)). Aug 1988. 94p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015787/JAW.

This report was prepared as an extension of work being preformed by EPRI assess the impact of 10CFR61 on the nuclear industry. With the recognition of Discrete Radioactive Particles (DRPs) as a potentially significant concern both with respect to the use of scaling factors in the estimation of quantities of isotopes controlled by 10CFR61, "Licensing Requirements for Land Disposal of Radioactive Waste", and in potentially interacting with Low Level Radioactive Waste (LLRW) Below Regulatory Concern (BRC) exemption criteria, this study was undertaken as an initial problem assessment. A survey was conducted gather existing information on DRPs and to determine the incidence of DRPs in operating nuclear power plants. During the course of the survey, operating nuclear power plants were polled regarding the incidence of DRPs, methods of detection, locations where found, isotopic analyses, and other relevant data. This information was compiled and is included in this report. In addition to the survey, and assessment was made of the range of skin doses attributable to DRPs as a function of particle activities and identified radionuclides and a determination was made of the impact of DRPs on the curie estimates made for difficult-to-measure isotopes restricted by 10CFR61. 10 refs., 15 figs., 18 tabs.

51215 **(EPRI-NP—5983) Assessing the impact of NRC regulation 10 CFR 61 on the nuclear industry: Final report.** Vance, J.N.; Helmholz, H.R.; Sutherland, A. (Electric Power Research Inst., Palo Alto, CA (USA); Vance and Associates, Ruidoso, NM (USA); NWT Corp., San Jose, CA (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Aug 1988. 177p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016201/JAW.

The objective of this study was to assess the impact on the nuclear power industry of the implementation of 10CFR61. The primary purpose was to identify areas where additional EPRI sponsored programs would be of benefit to utilities in conducting their compliance programs and in resolving current and potential problems or concerns. The literature concerning 10CFR61 implementation was reviewed to determine implementation costs, associated radiation exposure, methods and problems concerning curie estimates, the requirements concerning waste forms and verification testing, the potential impacts of volume reduction and alternate disposal technologies, and the possible consequence of extended fuel burnup. In some cases utilities were contacted for more current information. In an overall sense, the industry has been able to comply with the 10CFR61 requirements. The implementation costs and radiation exposure are small compared to the overall waste disposal costs. These are problems still in terms of waste form requirements and testing. It also appears here is justification for generic scaling factors for the long-lived, difficult-to-measure waste radionuclides.

51216 **(IAEA-TECDOC—434) Methodology and procedures for compilation of historical earthquake data. Report of a consultants meeting held in London, 18-21 March 1986.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 45p. (CONF-8603250—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703830/JAW.

From Consultants meeting on the methodology and procedures for compilation of historical earthquake data; London, UK (18 Mar 1986).

This report was prepared subsequent to the recommendations of the project initiation meeting in Vienna, November 25-29, 1985, under the IAEA Interregional project INT/9/066 Seismic Data for Nuclear Power Plant Siting. The aim of the project is to co-ordinate national efforts of Member States in the Mediterranean region in the compilation and processing of historical earthquake data in the siting of nuclear facilities. The main objective of the document is to assist the participating Member States, especially those who are initiating an NPP siting programme, in their effort to compile and process historical earthquake data and to provide a uniform interregional framework for this task. Although the document is directed mainly to the Mediterranean countries using illustrative examples from this region, the basic procedures and methods herein described may be applicable to other parts of the world such as Southeast Asia, Himalayan belt, Latin America, etc. 101 refs, 7 figs.

51217 **(INIS-mf—11235) Present and future place of nuclear power in the world and its role in relation to environmental risks and energy production.** Blix, H. (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 22p. (CONF-8703269—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703901/JAW.

From Managing environmental risks; Salzburg, Austria (26 Mar 1987).

This speech was delivered at a Seminar on Managing Environmental Risks, 1987. It states and enlarges on the three following propositions: First, that the world will need more energy - not least electric energy - energy savings and modified lifestyles will not be enough to compensate for new needs; Second, that our choice of energy mixes is one of the important factors deciding what future environmental risk and damage we shall live with; Third, that nuclear power offers us one of the most environmentally benign sources of energy generation. The paper points to coal and nuclear energy as the two principal realistic options for future large-scale production of electricity in the world. Questions regarding nuclear safety are discussed in particular the accident at Chernobyl. As regards the use of coal and gas it is concluded that it is imperative to tighten the emission restrictions for environmental reasons. It is also stressed that the use of nuclear power should not be examined in isolation. The Agency's nuclear safety standards are mentioned since they are being reviewed to see if some of them should be updated in the light of lessons from Chernobyl. 2 refs.

51218 (INIS-mf—11261, pp 34-40) **Criteria for NPP site selection with respect to meteorological parameters.** Artemova, N.E.; Moiseeva, T.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Criteria for the nuclear rower plant site selection are studied to ensure the population radiation safety with respect to the NPP radionuclide stack releases into atmosphere. The principles of the population dose evaluation and permissible release limits determination are formed. Meteorological factors are identified that have major effects on calculation of the average annual atmospheric dilution coefficient. A programme is suggested for additional meteorological and aerological observations to ensure the evaluation of specific micrometeorological features of the site in case of its location in a region with complicated relief of the terrain or frequent abnormal meteorological conditions. 4 refs.; 1 tab.

51219 (INIS-mf—11261, pp 78-89) **Development of an optimal monitoring network for NPP environmental control system.** Kyummel', M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A basic approach is described for determining an optimal distribution of radiation monitors in the environment of a nuclear installation. For areas located at different distances from the reactor the minimum monitor (gamma-ray dosemeters or thermoluminiscence dosemeters) numbers are calculated with regard to such parameters as the release height, radioactivity level, detector threshold, time of exposure, meteorological conditions. 4 refs.; 9 figs.

51220 (INIS-mf—11261, pp 90-95) **Radiation conditions due to Cs-137 and Sr-90 in the environment of Kozloduj NPP.** Petkov, T.N.; Zlatanova, R.I. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Detailed radiation monitoring data are presented for various components of biogeocenoses chain in the region of Kozloduj NPP for a period of five years (1976-1980). Within this period the monthly dependences of Sr-90 and Cs-137 fallouts were analysed over all monitoring points.Sr-90 and Cs-137 concentrations in milk did not exceed 970 mBq/l and 600 mBq/l respectively which correlate with the summer peaks in atmospheric fallouts. On this data base a conclusion has been drawn, that during normal NPP OPERATION THE RADIONUCLIDES RELEASED INTO THE ATMOSPHERE CAN NOT BE DISTINGUISHED FROM THE GLOBAL RADIOACTIVE FALLOUT BACKGROUND BY MEANS OF THE EXISTING INSTRUMENTATION AND MEASURING TECHNIQUES. 2 figs.

51221 (INIS-mf—11261, pp 96-102) **Evaluation of KozlodujNPP radioactive releases and their impact on the environment and population.** Dichev, G.; Khitov, G.; Keslev, D. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Organization method and equipment are considered for the monitoring of gas/aerosol, iodine-131 and water releases and wastes of Kozloduj NPP. Gas/aerosol and water radioactivity sources in WWER reactors are described and their contribution to the total annual amount of radioactive releases and wastes determined. Averaged data on the annual releases and wastes are presented for 8 years period of the NPP operation. The radioactive gas/aerosol and water release dependences on the reactor condition are estimated with regard to the maximum permissible concentrations and dose equivalents. The NPP radiation impact on the environment and population through the atmosphere and hydrosphere is evaluated. 5 tabs.

51222 (INIS-mf—11261, pp 151-154) **NPPs with WWER-440 reactors as sources of C-14.** Rublevskij, V.P. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The amount of total C-14 release from all NPPs with WWER-440 reactors in the USSR is presented. An evaluation has been made of the NPP impact on the regional environment due to C-14 released into the atmosphere with gas/aerosol effluents. The local population dose due to C-14 releases in NPP region is several orders of magnitude lower than the existing permissible levels. The major hazard from C-14 build-up in the environment is connected with long term radiation exposure of large population group (practically the entire mankind) and with inadequate knowledge about its relative biological effectiveness. 4 refs.; 3 tabs.

51223 (INIS-mf—11261, pp 18-27) **Using the individual and population dose criteria for NPP release standardization.** Knizhnikov, V.A.; Barkhudarov, R.M.; Likhtarev, I.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Approaches to the population and individual dose limits establishing are analyzed with the purpose of the NPP release standardization during site selection. From the analysis a conclusion has been drawn that meeting the current standardized dose limit requirement for the restricted population groups is sufficient for the NPP release reglamentation from the viewpoint of acceptable collective risk established in accordance with various modern concepts. The population dose criterion can be used as one of a number of estimated parameters during NPP site selection to optimize the release levels in the course of the 'risk/benefit' trade-offs. 23 refs.; 4 tabs.

51224 (INIS-mf—11261, pp 72-77) **Airborn releases monitoring as an essential part of the environmental control programme in CINR, Rossendorf.** Yanzen, K.; Shtajn, R.; Taut, G. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Monitoring methods that have been used in the system of the environment control during normal operation of nuclear installations in CINR, Rossendorf are described as well as the instrumentation base and calculation models for determining the radiation loads

in the environment. During airborn releases monitoring the major attention should be paid to iodine-131 which can be discharged, first of all, from an installation for isotopes production. In the course of adsorbents study with respect to their sticking efficiency the developed in CINR, Rossendorf so-called 'iodine-filament filter' has been proved to be more preferable than the ones employed earlier. This filter was used in the radiation safety monitoring system for the radioiodine identification in the airborn releases of a nuclear installation as well as in the CINR environment. 2 tabs.

51225 (INIS-mf—11261, pp 112-119) **Some radiation safety issues of the first Cuban NPP in Ernandes.** Padron, M.A.; Rodriges, Kh.M.; Ehrnandes, Kh. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The results of inspection of the first Cuban NPP region are discussed. A preliminary analysis of the radioactive releases impact on the environment has been carried out. The issues of a radiation monitoring system are considered including the arrangement of a monitoring stations set and preliminary programme for the environment inspection. The expected population doses both during normal NPP operation and due to accidents will be lower than the permissible limits. The radiation monitoring system is to be put into operation 2 years before the NPP start-up to accumulate sufficient statistics on the radiation background in the NPP region. 3 tabs.; 3 figs.

51226 (INIS-mf—11261, pp 127-132) **Radiation-hygienic evaluation of South-Ukrainian power complex project comprising hydroelectric and nuclear power plants.** Chumak, V.K.; Belousova, P.B.; Bogorad, V.I. 1984. (In Russian). (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A radiation-hygienic evaluation of South-Ukrainian power complex project is given. Transition fpom NPP closed water cooling systems to open circulating ones with multipurpose economic utilization of the water storage pools has required the evaluation of individual and population doses due to radionuclides intake with drinkable water, fish and agricultural products obtained from irrigated lands. The contribution of the latter is about 3%. 4 refs.; 1 tab.; 2 figs.

51227 **(NRPB-R—184) Uncertainty analysis of the foodchain and atmospheric dispersion modules of MARC.** Crick, M.J.; Jones, J.A.; Haywood, S.M.; Hofer, E. (National Radiological Protection Board, Chilton (UK); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). (National Radiological Protection Board, Chilton (UK)). May 1988. 47p. H.M. Stationery Office, London, price Pound 5.00.

This report describes the application of one uncertainty method to the foodchain and atmospheric dispersion modules of the NRPB accident consequence assessment code MARC. It discusses the reasons for studying the uncertainty in each module rather than in the whole code, and also the problems involved in describing the range of value which might reasonably be assigned to different parameters. The report also considers what quantitative statements can be made about the uncertainty on the predictions of the two modules of MARC.

51228 **(SNV—3110) Radionuclides in sedimenting material from the Biotest basin.** Notter, M. (National Swedish Environmental Protection Board, Solna). Apr 1986. 25p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754497/JAW.

In the biotest basin, outside the nuclear power plant at Forsmark, two sedimentation traps have been stationated during 1984. Samples have been collected every fortnight. The total amount of the sedimented material, organic content and the concentration of radionuclides have been determined for the samples. A subsample will be examined by microscope, and the results reported elsewhere. The sedimentation rate in the biotest basin is low. A maximum sedimentation rate, about 2.4 mg/cm/sup 2/ day, was found in the summer. During the rest of the year it declines to 1 mg/cm/sup 2/ day. Usually the nuclides Co-60, Zn-65, Mn-54, Ag-110m, Co-58 and K-40 are determined and occasionally also Nb-95 and Cr-51. The concentration is relatively high, about 400-8000 Bq/kg d.w. for Co-60 and Zn-65. In some samples even much higher values were found. One explanation could be that some fragments of ion exchanger, which might be discharged with the cooling water, was recovered in the traps. There was no correlation between the radionuclide concentration in the samples and the amount of radionuclides in the discharge at the southern sampling station. The station is located off the main current and the influence of the discharge varies with the wind. At the other location, about 800 m to the north, in the middle of the stream, there is good correlation between the nuclide concentration and the discharge. Particularly for Co-60 and Zn-65 and to some extent even for Mn-54. For Ag-110m no correlation have been determined.

51229 **(TVA/PUB—88/6) Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1987.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). Apr 1988. 122p. NTIS, PC A07. Order Number DE88016076/JAW.

This report describes the environmental radiological monitoring programs conducted by TVA in the vicinity of Browns Ferry Nuclear Plant in 1987. The program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Samples are taken from stations in the general area of the plant and from areas not influenced by plant operations. Station locations are selected after careful consideration of the weather patterns and projected radiation doses to the various areas around the plant. Material sampled includes air, water, milk, foods, vegetation, soil, fish, sediment, and direct radiation levels. Results from stations near the plant are compared with concentrations from control stations and with preoperational measurements to determine potential impacts of plant operations. The vast majority of the exposures calculated from environmental samples were contributed by naturally occurring radioactive materials or from materials commonly found in the environment as a result of atmospheric nuclear weapons fallout. Small amounts of Co-60 were found in sediment samples downstreams from the plant. This activity in stream sediment would result in no measurable increase over background in the dose to the general public. 3 refs., 2 figs., 34 tabs.

51230 **(TVA/PUB—88/9) Radiological impact assessment report for the Sequoyah Nuclear Plant, January-December 1987.** Lee, B.E. (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). 1987. 40p. NTIS, PC A03. Order Number DE88016078/JAW.

Potential doses to individuals and populations have been calculated for the time period January 1 through December 31, 1987, in compliance with the requirements of Radiological Effluent Technical Specification 6.9.1.9. Dose calculations are based on Regulatory Guides, to determine compliance with the dose objectives contained in 10 CFR 50 Appendix I and 40 CFR 190. The dose calculations have been made using the measured releases as input in the Gaseous Effluent Licensing Code (for gaseous releases) and the Quarter Water Assessment Code (for liquid releases). Dispersion of radioactive effluents in the environment has been calculated using meteorological data and river flow data measured during this period. 5 figs., 16 tabs.

51231 **(TVA/PUB—88/12) Browns Ferry Nuclear Plant radiological impact assessment report, July-December 1987.** Lee, B.E. (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). 1987. 45p. NTIS, PC A03/MF A01. Order Number DE88016080/JAW.

Potential doses to individuals and populations have been calculated for the time period July through December in compliance with the requirements of Radiological Effluent Technical Specification. Dose calculations are based on Regulatory Guides, and NUREG/CR-1004 to determine compliance with the dose objectives contained in 10 CFR 50, Appendix I, and 40 CFR 190. Measured plant releases for the reporting period are used as input in the Gaseous Effluent Licensing Code (for gaseous releases) and the

Quarterly Water Assessment Code (for gaseous releases) to estimate dose. Dispersion of radioactive effluents in the environment has been calculated using meteorological data and riverflow data measured during this period. 4 figs., 15 tabs.

51232 **(TVA/PUB—88/13) Browns Ferry Nuclear Plant radiological impact assessment report, January-June 1988.** Lee, B.E. (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). 1988. 51p. NTIS, PC A04/MF A01. Order Number DE88016079/JAW.

Potential doses to maximum individuals and the population around Browns Ferry are calcuated for each quarter. Measured plant releases for the reporting period are used to estimate these doses. Dispersion of radioactive effluents in the environment is estimated in accordance with the guidance provided and measuring during the period. Using dose calculation methodologies which are described in detail in the Browns Ferry Offsite Dose Calculation Manual, the doses are calculated and used to determine compliance with the dose limits contained in Browns Ferry's Operating License. In this report, the doses resulting from releases are described and compared to quarterly and annual limits established for Browns Ferry.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 50730, 51099, 51209, 51259, 51272, 52896

51233 **(DOE/ER/75241—T1) University research reactors in the United States: Their role and value.** (National Research Council, Washington, DC (USA). Committee on University Research Reactors). 1988. Contract AC01-86ER75241. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88014935/JAW.

This report is primarily addressed to the people who make decisions affecting the levels of future university reactor programs URR: university administrators, department heads, federal policy makers, state and local policy makers, those in industry and government who depend upon a supply of nuclear-trained personnel, and those who are concerned with the future of the many sciences that benefit from the unique capabilities of nuclear-based techniques as well as from the nuclear sciences themselves. The major thrust of this report is to illustrate the scientific and social benefits and contributions associated with well-managed and well-funded university reactor programs. The intent is to help a decision maker gain a perspective and appreciation of the scientific, academic, social, and technical values of URR programs. The report also examines the role of university-like reactors in Europe, where a productive community of researchers is apparently served in an exemplary manner. The committee, assesses the security and safeguard needs at small reactors in a university setting in order to help gain a perspective on the potential hazards and relative risks involved. The last chapter discusses the kind of commitment and support needed if a significant population of URRs is to remain productive. 83 refs., 11 figs., 2 tabs.

51234 **(EGG-M—88286) Neutronics design of a medical therapy reactor.** Neuman, W.A.; Parsons, D.K.; Lake, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 10p. (CONF-880911—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015179/JAW.

From International reactor physics conference; Jackson Hole, WY, USA (18 Sep 1988).

The development of a Medical Therapy Reactor (MTR) facility for the treatment of Glioblastoma Multiforme and other presently incurable cancer types is underway at the Idaho National Engineering Laboratory (INEL). This paper addresses the feasibility of utilizing existing reactor technologies to deliver therapeutic doses of epithermal neutrons with minimal fast neutron and gamma contaminants. The two primary fuel candidates are a 10 wt% U-235 enriched UO_2 fuel and 45 wt% uranium in UZrH, 20 wt% U-235 enriched hydride fuel. Both candidates can produce a 10^{14} n/m^2-s epithermal neutron flux at the patient end of a neutron filter with power levels below 10 MW/sub th/. This flux level results in a patient treatment period of about 10 minutes. The fast neutron and gamma contaminates of the beam during the treatment period are <2 Gy and <0.5 Gy, respectively. The facility configuration permits simultaneous treatment of multiple patients. With the expected operation schedule of approximately 2000 treatment periods per beam port per year, the reactor core lifetime is the same as the facility lifetime of 30 years and no refueling is necessary.

51235 **(INIS-mf—11293) Performance test of TR-2 research reactor cooling system.** Yavuz, H.; Ozal, Y.; Anac, H.; Sevdik, B.; Taylan, S. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy; Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1987. 1p. (CONF-8709334—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703911/JAW.

From 6. national congress on heat science and technology; Istanbul, Turkey (21 Sep 1987).

Will be published.

51236 (INIS-SU—9/A, pp 73-76) **Fast pulsed reactor.** Blokhintsev, D.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

History of construction IBR-1, IBR-30 and IBR-2 fast pulsed reactors is described in brief. The two part core forms the basis of the construction. One part is immovable, the other is located in a fast rotating rotor. When combining rotor and immovable core reactor becomes supercritical.

51237 (INIS-SU—38/A, pp 82-84) **Code to calculate transition and emergency processes in branched pipelines of steam generating systems.** Parafilo, L.M. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

Elements of calculational area, structure of data and some parameters of the APPRO universal program intended for investigation into dynamics of complex pipeline systems, such as the Bilibin nuclear heat and power reactor circiut are described. Calculation of systems, containing coolants, separators, pumps, thermal power sources is provided. Heat exchange with outer space is estimated. Calculation of the regimes under system normal operation and in emergency conditions including cases of arbitrary circuit emergency breaks is ensured. Software facilitating modification of the investigated system including its expansion at conservation of earlier formed data is provided. The results of the calculation of this process after break of one of the loops of natural circulation of a two-loop system are presented. 2 figs.

51238 **(IWGFPT—28) Power ramping, cycling and load following behaviour of water reactor fuel: Proceedings.** (International Atomic Energy Agency, Vienna (Austria)). May 1988. 167p. (CONF-8705237—). NTIS (US Sales Only), PC A08; 1; GPO Dep. Order Number DE88014011/JAW.

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Important progress has been achieved during an IAEA Specialists' Meeting on the same topic which was held in Petten, Netherlands, from 8-9 September 1982 (Ref. IWGFPT/14). During the past five years so much progress has been accomplished that load follow has been implemented as a regular operating mode in some countries. Thus, a consistent feed-back from industrial experience is becoming available. The objective of this Technical Commmittee Meeting is to review the "State-of-the-Art," make critical comments and recommendations with the aim of improving fuel reliability and assure integrity of the cladding and core materials when subjected to ramping and cycling sequences. The Meeting was organized in three sessions: "Mechanical Behaviour and Fission Gas Release"; "Power Ramping and Power Cycling Demonstration Programmes in Research Reactors"; "Fuel Behaviour in Power Reactors." Between the sessions, the session chairmen, together with the speakers, prepared and presented reports with summary, con-

clusions and recommendations of the individual sessions. These reports are added to this summary report.

51239 **(JAERI-M—88-078) Neutronic and thermo-hydraulic design of LEU core for Japan Research Reactor 4.** Arigane, Kenji; Watanabe, Shukichi; Tsuruta, Harumichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Apr 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754569/JAW.

As a part of the Reduced Enrichment Research and Test Reactor (RERTR) program in JAERI, the enrichment reduction for Japan Research Reactor 4 (JRR-4) is in progress. A fuel element using a 19.75 % enriched UAlx-Al dispersion type with a uranium density of 2.2 g/cm/sup 3/ was designed as the LEU fuel and the neutronic and thermo-hydraulic performances of the LEU core were compared with those of the current HEU core. The results of the neutronic design are as follows: (1) the excess reactivity of the LEU core becomes about 1 % Δk/k less, (2) the thermal neutron flux in the fuel region decreases about 25 % on the average, (3) the thermal neutron fluxes in the irradiation pipes are almost the same and (4) the core burnup lifetime becomes about 20 % longer. The thermo-hydraulic design also shows that: (1) the fuel plate surface temperature decreases about 10 deg C due to the increase of the number of fuel plates and (2) the temperature margin with respect to the ONB temperature increases. Therefore, it is confirmed that the same utilization performance as the HEU core is attainable with the LEU core.

51240 (KURRI-TR—291, pp 23-27) **Automatic control and stabilization of KUR-ISOL power supply.** Okano, Kotoyuki. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

Modification of KUR-ISOL is currently being carried out. The report describes major improvements that have been or are planned to be made. The diameter of the ionizer and filament winding largely affects the temperature. An ionizer that is small in size and gas release has been designed and constructed. Heating is achieved by automatic filament outgassing and bombardment outgassing. An ion-source power supply is designed so that these two processes can be controlled appropriately and that the power will be rapidly decreased when the vacuum deteriorates. To maintain the stability of the electron bombardment current and voltage, a stabilizing circuit is constructed which produces signals to control the power to the filament if the bonbardment current exceeds a certain limit. The newly designed power supply for the electromagnet is capable of remote control, automatic sweeping and computer control. It is equipped with a mass peak stabilizer incorporating a ratemeter. A centralized control and monitoring console is also constructed which can perform centralized control of various processes and continuous recording. Various improved measuring devices are designed which are required to construct a high-efficiency measuring sys¹em to serve for measurement of exotic nuclei. Such devices include a high-efficiency X-γ N-type HP Ge detector, high-efficiency Si(Li)-β coincidence spectrometer, four-counter goniometer and Ge multiple-counter goniometer. (Nogami, K.).

51241 **(LA—6016-SOP-Rev.2) Technical specifications for the Los Alamos Critical Experiments Facility.** Plassmann, E.A. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014967/JAW.

This document is to satisfy the requirement for technical specifications spelled out in the Department of Energy Order 5480.1, Chapter VI, "Safety of DOE-Owned Reactors." The following technical specifications update the document "Technical Specifications for the Pajarito Site Critical Experiments Facility" (June 1975, revised December 1980). 17 refs., 3 figs.

51242 **(NEI-NO—46) Annual report 1987.** (Institute for Energy Technology, Kjeller (Norway)). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754479/JAW.

Work at the Institute for Energy Technology (IFE) comprises both nuclear and non-nuclear activities. The objectives and framework of the nuclear activities are largely determined by governmental authorities. The international Halden project plays an important role with regard to Norwegian preparedness in the field of nuclear safety, and it also provides a think-tank for work on vital international nuclear safety technology (fuel technology, safety and operation). In addition, IFE provides an essential national function, supplying Norwegian hospitals with isotopes for medical uses, produced using the JEEP II reactor at Kjeller. This reactor is also an important tool for basic physics research.

51243 **(ORNL/M—550) Reduced enrichment fuel: Performance penalties, costs, and benefits for the ANS [Advanced Neutron Source] reactor.** West, C.D.; Wilfert, D.K. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014888/JAW.

The relevant Department of Energy orders addressing the physical protection of fissionable material do not distinguish between high- and medium-enriched fuel for the Advanced Neutron Source (ANS) reactor; therefore, potential security advantages could only be realized if low-enriched fuel were adopted. For ANS, the security and safeguards benefits of even low-enriched uranium are slight, because existing manufacturing, transportation, and storage arrangements for weapons-grade material at the Oak Ridge complex and at the fuel fabrication plant would be used. The added safeguards and security costs of using highly enriched fuel might be around $100K. In contrast, the performance and cost penalties of using a low-enrichment core are very large. A conservative estimate is that a highly enriched 300-MW core can give about 65% greater flux for neutron scattering than a low-enrichment one. To obtain the same flux from a low-enriched core, one would have to raise the power level to nearly 600 MW, increasing the construction cost by more than $100M and the annual operating cost by about $13M. 2 figs., 13 tabs.

51244 **(PNL-SA—15512) Tensile properties of neutron irradiated A212B pressure vessel steel.** Hamilton, M.L.; Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 24p. (CONF-861044—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014745/JAW.

From 25. Hanford Life Sciences symposium: radiation protection-a look to the future - celebrating four decades of research at Hanford; Richland, WA, USA (21 Oct 1986).

A212B steel is the primary constituent of the pressure vessel of the High Flux Isotope Reactor (HFIR). Most of the existing data on mechanical properties of this and related steels are for higher temperatures and damage rates than those to which the HFIR pressure vessel is subjected. Data at lower temperatures and damage rates are, therefore, necessary to estimate the performance of A212B steel at the conditions of service, provided that correlations can be developed which are applicable to data obtained at different temperatures, damage rates and neutron spectra. To add to the data base for A212B steel at lower temperatures and over a range of damage rates, miniature tensile specimens of A212B were irradiated at 90{degree}C in the Omega West Reactor (OWR), receiving doses from 9 {times} 10^{22} to 9 {times} 10^{23} total n m/sup {minus}2/ (0.002 to 0.02 dpa) at a damage rate of 5 {times} 10/sup {minus}8/ dpa s/sup {minus}1/. Room temperature tensile tests showed more than a 50% increase in yield strength at the highest exposure. When dpa is used as the exposure parameter, the observed changes in yield strength of A212B are the same as those produced in A302B pressure vessel steel irradiated both in OWR and with 14 MeV neutrons in RTNS-II. At 90{degree}C, A302B shows little sensitivity to either neutron spectrum differences or to damage rates ranging from 3 {times} 10/sup {minus}11/ to 5 {times} 10/sup {minus}8/ dpa s/sup {minus}1/. Based on the similar behavior of A212B and A302B in OWR, it appears that one can assume that A212B is similarly insensitive to displacement rate at low temperatures for levels above about 3 {times} 10/sup {minus}11/ dpa s/sup {minus}1/. 13 refs., 5 figs.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 51410

51245 **(WHC-SA—0135) Flux shaping in N Reactor: A method to retard graphite stack distortions.** Nicklas, R.J.; Toffer, H. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-87RL10930. 12p. (CONF-880748—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013674/JAW.

From American Nuclear Society topical meeting on nuclear power plant life extension; Snowbird, UT, USA (31 Jul 1988).

N Reactor, a graphite moderated reactor operated for the Department of Energy by Westinghouse Hanford Company, has experienced graphite distortion over its 24 years of operation. Graphite is a highly anisotropic material. Polycrystalline forms, as used in N Reactor, are moderately anisotropic. Prolonged exposure to high energy neutrons and elevated temperatures has resulted in dimensional distortions in graphite moderator blocks. Judicious use of fuel distributions and control rod manipulations can result in flux distributions that will retard the rate of localized distortions. The flux-flattening program at N Reactor was initiated to control flux levels in locations with historic high fluence values and shift power production to regions that have experienced low fluence. The program is implemented through axial enrichment variations in fuel charges and selective use of control rods. Complex three dimensional analyses supported by a number of test loadings and monitored by a series of incore detectors have been essential to this effort. Projections indicate that operation of the reactor in this mode will retard graphite growth equivalent to three to five years of operation. N Reactor is currently being placed in a standby mode. Should future operation of the reactor be required, flux flattening could substantially extend the duration of its mission. 1 ref., 8 figs.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 50846, 51104, 51122, 51148, 51154, 51200, 51210, 51225, 51233, 51241, 51390, 51406, 51834, 51836, 51838, 51864, 51977, 52176, 52454, 52751, 52752, 52753

51246 (CONF-760202—, pp 210-213) **Meaningful radiation worker training for temporary craftsmen.** Williams, S.L. (NUS Corporation, Rockville, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The carefully organized Radiation Worker Training Program presented to permanently assigned personnel at a power reactor facility too often falls by the wayside when temporary craftsmen are brought in for an outage. Even though these temporary workers will frequently be assigned to outage jobs with high radiation and/or contamination exposures, their Radiation Worker Training is often squeezed into an already busy schedule, thus reducing its effectiveness. As an aid for evaluating the effectiveness of an existing Radiation Worker Training Program for temporary craftsmen or for setting up a new program, the following guides are presented and discussed in this paper: the training environment; the interest and meaningfulness of the presentation; the method or methods used for presentation of the training information; the use of demonstrations; trainee participation; and, measuring the amount and type of information retained by a trainee. Meaningful Radiation Worker Training for temporary craftsmen can pay big dividends. Craftsmen can be expected to make fewer mistakes, thus reducing radiation exposure and lessening the chance for the spread of contamination. The craftsmen will also benefit by being able to work longer and utility management will benefit by having lower outage costs.

51247 (CONF-760202—, pp 214-220) **Radiation protection training in Ontario Hydro.** Sparkes, R.K. (Nuclear Training Centre, Rolphton, Ontario (Canada)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Ontario Hydro provides extensive training for its rapidly growing nuclear staff at a nuclear training center and at nuclear stations and radiation protection training, the responsibility of the health physics department, forms an important part of the training. Radiological safety responsibility is shared by all staff and several levels of radiation protection training are offered. RPT #3 is a basic course to prepare the individual to look after his own radiological safety on the job. RPT #2 provides a more detailed understanding and prepares experienced personnel to be responsible for the radiological safety of others. RPT #1 is an advanced course for persons with significant responsibility for radiological safety. Training in station radiation protection procedures is also offered at each station by a radiation control supervisor. Radiation protection qualifications are awarded on the basis of training and experience. All training emphasizes the capabilities to anticipate, assess and protect in radioactive work areas. A practical training facility has been constructed and completely fitted with instruments and protective equipment and provides a radioactive environment where trainees demonstrate exposure and contamination control.

51248 (CONF-760202—, pp 512-519) **Health physics experience during replacement of heat transport pressures tubes in a Candu Reactor.** Watson, D.A.; Bieber, C.; Macphee, R. (Pickering G.S., Ontario (Canada)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

In August 1974, significant quantities of heavy water were discovered in the annulus between the pressure tubes and calandria tubes in Unit #3 at Pickering G.S. (4-500 MWe Candu Reactors). The pressure tube was defuelled, isolated and removed from the calandria using tooling and equipment developed at the time. The identification removal and replacement of the first tube consumed 78 man-rem. A further 16 tubes were subsequently found defective in Unit #3 and were replaced over the period August 1974 - March 1975 with an external dose consumption of 517 rem. Considerable effort was spent to develop procedures and equipment that would reduce whole body exposure, e.g., use of shielded enclosures, remote ultrasonic scanning techniques to locate cracked tubes, development of rehearsal facilities, use of closed circuit television, etc. This resulted in a decrease of approximately 11 man-rem per tube during replacement of 12 tubes in Unit 4 in late 1974 Radiological conditions at the work location consisted of general gamma fields of several hundred mrem per hour; beams up to 120 rem per hour; contact dose rates on pressure tubes up to 100,000 rem/hour; and tritium (TDO) concentrations from 2-100 MPCa = 10 $\mu Ci/m^3$). Work will continue into early 1976 to replace approximately 50 pressure tubes in Unit 4.

51249 (CONF-760202—, pp 529-534) **Occupational radiation exposure experience at light water power reactors.** Murphy, T.D.; Nehemias, J.V. (Nuclear Regulatory Commission, Washington, DC (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The occupational radiation exposure data available to the NRC from power reactor licensees are described, discussed and summarized. These data, as reported in annual reports and the documents NUREG 75-032 and WASH-1311, have helped to identify those activities and design features which cause significant occupational radiation exposure in light water reactor power plants. This identification provides a basis for the health physics community, the utility industry and other components of the nuclear power industry to develop design and operational improvements which will maintain radiation exposures as low as is reasonably achievable, as required of licensees by 10 CFR Part 20. It also assists NRC staff in reviewing radiation protection programs of license applicants, in developing regulations and regulatory guidance, and in inspecting licensees, by focusing attention on those areas that are significant causes of occupational radiation exposure.

51250 (CONF-760202—, pp 535-538) **Comparison of design radiation levels for a nuclear power plant (PWR) with operation levels collected during initial start-up and values collected after one year of operation.** Gutwein, E.E.; Buring, M.R. (Gilbert/Commonwealth, Inc., Reading, PA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Operational radiation levels collected at Three Mile Island Nuclear Station have been compared with design radiation levels provided by the architect-engineer. Sources of operational data included radiation levels from the Biological Shield Survey, area TLD information, routine radiation surveys and stationary area monitors. Data was collected over a one year period. Values differing from design values were noted as were values that changed significantly over the observation period. Further analyses were conducted to better understand the source of any radiation problems so that the proper corrective action can be taken.

51251 (CONF-760202—, pp 553-561) **^{16}N skyshine survey at a 2400 MW(t) nuclear power plant.** Phillips, C.R. (Environmental Protection Agency, Montgomery, AL (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A field study was executed to determine environmental levels, distribution, and composition of turbine-contributed ^{16}N gamma radiation from an operating boiling water reactor electric generating plant. Exposure measurements made with Pressurized Ionization Chambers (PIC's) at several distances and in several directions from the turbine building indicated that ^{16}N skyshine rather than direct gamma exposures contributed the major portion of environmental exposures. Power level and distance dependencies were determined and a predictive model indicated that a distance of 500 meters and a power level of 801 MW(e) would yield a dose rate of 10 mrad/yr.

51252 (CONF-760202—, pp 639-646) **Control of occupational radiation exposures in TVA nuclear power plants - design and operating philosophy.** Belvin, E.A.; Lyon, M.; Beasley, E.G. Jr.; Zobel, W.; Stone, G.F. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

TVA has some 21,000 MWe of nuclear generation in various phases of design, construction, or operation. When Browns Ferry was designed in the late 1960's, there were no guidelines available regarding implant radiation control features, so TVA relied on good engineering and health physics judgement in developing its design and operating criteria for radiation protection. After two years of operation at Browns Ferry, the authors experience shows that their design criteria were in most cases adequate or more than adequate. However, several areas present continuing problems relative to radiation and contamination control. In view of the recent NRC ALARA guidelines, they have instituted a program to ensure that the ALARA concept is made an integral part of their design and operating plans. Administrative documents were issued giving management support to the ALARA concept. A 4-member management audit team consisting of representatives from their design, operating, and radiation protection groups was established to review the effectiveness of radiation protection design features and operating activities on a plant-by-plant basis. Reports and recommendations from these audits are sent to top-level management staff. Their goal is to maintain an audit-appraisal system consisting of in-plant awareness of radiation and contamination conditions, assessment of trends in occupational radiation exposures, and feedback to their designers regarding problems encountered during operation and maintenance activities.

51253 (CONF-760202—, pp 672-678) **Application of the ALAP concept to occupational exposure at operating light water reactors.** Dickson, H.W.; Cottrell, W.D.; Jacobs, D.G. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The application of the as-low-as-practicable (ALAP) concept to radiation exposure of workers at light-water reactors (LWR's) has recently received increased attention. The purpose of this project is to investigate the means by which occupational exposure at operating LWR's can be reduced to the lowest practicable levels. Nine LWR stations, including 16 operating reactors, were studied in Phase I of the project to identify significant sources of exposure and to determine the magnitude of the exposures. A complete site review consists of compiling information from safety analysis reports, plant technical specification, and radiation exposure records coupled with an on-site visit for discussions with plant personnel, observation of procedures, and measurement of radiation levels. In Phase II, specific problem areas are being studied in-depth with regard to corrective measures to reduce exposure. Information has been collected on exposure from valve maintenance and repair. Corrective measures will be evaluated with respect to ease of application and cost effectiveness. The results of this study will serve as technical backup for the preparation of regulatory guides.

51254 **(CONF-880815—6) The chemistry and behavior of iodine-vapor species in nuclear plant air-monitoring sampling lines.** Wright, A.L.; Fish, B.R.; Beahm, E.C.; Weber, C.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016357/JAW.

From 20. DOE/NRC nuclear air cleaning conference; Boston, MA, USA (22 Aug 1988).

Investigations related to characterization of iodine species vapor deposition in air-monitoring sampling lines are being performed by the Tennessee Valley Authority (TVA). These investigations involve determination of iodine chemical species airborne in containment under severe-accident conditions and the development of models to predict vapor deposition in sampling lines. 13 refs., 1 fig., 2 tabs.

51255 **(CONF-8806137—2) Chemistry and mass transport of iodine in containment.** Beahm, E.C.; Weber, C.F.; Kress, T.S.; Shockley, W.E.; Daish, S.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016353/JAW.

From 2. C.S.N.I. workshop on iodine chemistry; Toronto, Canada (2 Jun 1988).

TRENDS is a computer code for modeling behavior of iodine in containment. It tracks both chemical and physical changes and features such as calculation of radiation dose rates in water pools , radiolysis effects, hydrolysis, and deposition/revaporization on aerosols and structural surfaces. Every attempt has been made to account for all significant processes. Reaction rate constants for iodine hydrolysis and radiolysis were obtained by a variable algorithm that gives values closely modeling experimental data. TRENDS output provides the distribution of iodine in containment and release from containment as a function of time during a severe accident sequence. Initial calculations with TRENDS have shown that the amount of volatile iodine released from containment is sensitive to the value of the liquid-gas (evaporation) mass transport coefficient for I_2. 7 refs., 4 figs., 3 tabs.

51256 **(DOE/NE/37959—19) An integrated architecture for signal validation in power plants.** Upadhyaya, B.R.; Kerlin, T.W.; Holbert, K.E.; Gloeckler, O.; Morgenstern, V.M.; Qualls, A.L.; Eryurek, E. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 1988. Contract AC02-86NE37959. 7p. (CONF-880899—4). NTIS, PC A02. Order Number DE88017076/JAW.

From IEEE international symposium on intelligent control; Arlington, VA, USA (24 Aug 1988).

Since the incident at Three-Mile-Island II, computerized plant status display systems, human factors consideration in control room design, and plant monitoring devices available to the plant personnel have seen a tremendous growth. One such operator aid is a plant signal validation system (SVS). The architecture of the SVS consists of several parallel signal processing modules and each module operates independent of the others. The functional coordination of the modules and the decision about the overall signal status are performed by a system executive. The various techniques have been tested using pressurized water reactor (PWR) plant operational data. 7 refs., 6 figs.

51257 **(EGG-M—34587) Heat transfer effects in severe accident integral analyses.** Dallman, R.J.; Bayless, P.D.; Chambers, R.; Han, J.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 15p. (CONF-880724—23). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015086/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

How much energy is removed from the core and where it is deposited are important considerations in severe accidents. The core heatup rate will affect the timing of the damage progression and the nature of the core debris. Heat transferred from the core to other structures in the reactor coolant system can affect the structural integrity of the piping and the fission product transport and retention. The SCDAP/RELAP5 computer code has been used to simulate a hypothetical station blackout transient in the Surry nuclear power plant. The natural circulation flows present during this high pressure sequence transferred energy from the core to other structures in the reactor coolant system. Heating of the piping in the coolant loops could lead to the creep rupture failure of the pressurizer surge line prior to melt-through of the reactor vessel lower head. Studies of insulation performance indicate that the piping temperatures are not very sensitive to the boundary conditions on the outer surface.

51258 **(EGG-M—88132) SASSYS analysis for PRISM UTOP with air dump HX for safety tests.** Atkinson, S.A.; Polkinghorne, S.T.; Fisher, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 7p. (CONF-880506—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015125/JAW.

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

A PRISM reactor and intermediate heat transport system were modeled using the SASSY-1 code with heat rejection by either a steam generator or an air dump heat exchanger (ADHX). An ADHX is considered in order to decrease prototype safety test costs. Analysis results were compared for an unprotected transient overpower (UTOP). The simple SASSYS steam generator model was benchmarked to General Electric UTOP results using ARIES-P. A comparison of the benchmarked SASSYS steam generator model results obtained with an ADHX show an ADHX can adequately simulate steam system transient response for the PRISM UTOP.

51259 **(EGG-TFM—8082) Advanced Test Reactor large break loss-of-coolant accident break spectrum study.** Burtt, J.D.; Dobbe, C.A.; Wheatley, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1988. Contract AC07-76ID01570. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015091/JAW.

This report documents work performed at the Idaho National Engineering Laboratory in support of the Department of Energy's safety review of the Advanced Test Reactor. Four large break loss-of-coolant transients were calculated using the RELAP5/MOD2 computer code to determine the worst transient in terms of vessel inventory loss and core cladding temperatures.

51260 **(EGG-TMI—7992) TMI-2 accident evaluation program sample acquisition and examination plan for FY-1988 and beyond.** Russell, M.L.; McCardell, R.K.; Broughton, J.M.; Akers, D.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-76ID01570. 256p. NTIS, PC A12. Order Number DE88015134/JAW.

The purpose of the Three Mile Island Unit 2 (TMI-2) Accident Evaluation Program Sample Acquisition Examination (AEP SA&E) Program is to develop and implement a test and inspection plan that completes the current-condition characterization of: (a) the TMI-2 equipment that may have been damage events and (b) the TMI-2 core fission product inventory. The characterization progam includes both sample acquisitions and examinations and in situ measurements. Fission product characterization involves locating the fission products as well as determining their chemical form and material association. The intent of this document is to describe the TMI-2 Sample Acquisition and Examination Plan in a manner that provides sufficient information for "stand alone" comprehensives. 12 refs., 30 figs., 16 tabs.

51261 **(GRS-F—163) List of reports in the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reported period: October 1 - December 31, 1987.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Feb 1988. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754309/JAW.

The list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation of the Federal Minister for Research and Technology (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programme of the BMFT, reporting organization. The list of reports appears quarterly. (orig.) With 142 refs.

51262 **(INIS-GB—161) Explanatory memorandum on European Community Document 6323/87: proposal for a Council decision on a Community system of rapid exchange of information in cases of abnormal levels of radioactivity or of a nuclear accident.** (Department of Energy, London (UK); Commission of the European Communities, Brussels (Belgium)). 24 Jun 1987. 2p. (COM—87-135). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754525/JAW.

The Council of the European Commnity proposes a system of rapid exchange of information in cases of abnormal radioactivity or a nuclear accident. In addition to the existing procedures of early notification drawn up by the International Atomic Energy Authority this proposes a further notification system between member states of the European Community. Under this there would be notification, not only of accidents with possible transboundary effects, but of any accident for which emergency measures are taken to protect the public. However, the United Kingdom would prefer the trigger of these procedures to be abnormally high radiation levels rather than the introduction of emergency measures. (U.K.).

51263 **(INIS-GB—162) Explanatory memorandum on European Community Document -mutual medical assistance in the case of a nuclear accident.** (Department of Health and Social Security, London (UK); Commission of the European Communities, Brussels (Belgium)). 8 Jul 1987. 5p. (COM—87-206). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754526/JAW.

The report lists the Commissions proposals for further action on its suggestion of mutual health assistance in the event of a nuclear accident. These include surveys and studies, further research on the medical treatment of radiation casualties and the methodology of epidemiological investigations, the promotion of contacts between experts and the attempt to assemble a handbook listing facilities and procedures for mutual assistance. The memorandum explains some of the points further under the headings, ministerial responsibility, legal and procedural issues and policy implications. The United Kingdom position is then stated. The UK government welcomes the proposals provided there is no duplication of work

already covered by the IAEA Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency. (U.K.).

51264 (INIS-mf—11696, pp 75-84) **What happened in Chernobyl?.** Finckh, E.; Gremm, O. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Physikalisches Inst.; Kraftwerk Union A.G., Erlangen (Germany, F.R.). Hauptabteilung Sicherheitskonzepte). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

The author summarily evaluates the cause and sequence of the Chernobyl reactor accident. A table supplies data on major fission products released on explosion, and maximum air-borne activities.

51265 (INIS-mf—11696, pp 85-102) **Radioactivity, radiation exposure and health effects of the Chernobyl reactor accident for the FRG.** Sauer, R.; Schmidt, T. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Klinik und Poliklinik fuer Strahlentherapie; Staedtisches Klinikum Nuernberg (Germany, F.R.). Abt. fuer Medizinische Physik). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

Radiation exposure totalling from external irradiation, inhalation and ingestion is assessed. This assessment gives the mean effective life-time dose equivalent for the FRG. Data indicate the radiation exposure due to the Chernobyl reactor accident to be a small but additional hazard. (52 references to literature).

51266 **(INIS-mf—11701) Safety engineering measures selected according to the goal of protection in mind.** Weidlich, H.; Seidl, T. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.)). (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.)). 1987. 23p. (In German). (CONF-8710356—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754315/JAW.

From GRS experts' discussion on operations experiences and reactor safety; Muenchen, F.R. Germany (29 Oct 1987).

The publication explains how the goal-oriented selection procedure is used in order to systematically describe the conceivable plant conditions within the framework of the studies of possible and feasible measures of in-plant emergency protection. It is also shown that a purposeful evaluation of operating data and experience by means of precursor studies, as well as an evaluation of plant-specific risk assessments, can help in setting up for a given plant a priority list for the measures to be studied and prepared for.

51267 **(INIS-mf—11737) Lingen nuclear power plant. Technical report. January - June, 1987.** (Kernkraftwerk Lingen G.m.b.H. (Germany, F.R.)). 1987. 14p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754316/JAW.

The technical report gives an account of the decommmissioning and dismantling work in the period given. Particular attention is given to the following items: Primary loop, wastes, decommissioning of waste water treatment plant, personnel monitoring, radioactive wastes, chemical aspects, conventional plant equipment, nuclear components - waste water treatment, radiochemical aspects. (HSCH).

51268 **(INIS-mf—11818) One year after Chernobyl. Physical and social aspects. Exhibition in the information centre of the Konstanz University Library, April 22 to May 21, 1987. Catalogue and bibliography.** Lehmler, W.; Schmitz-Veltin, G. (comps.). (Konstanz Univ. (Germany, F.R.). Bibliothek). 1987. 144p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754661/JAW.

The exhibition has been induced by the observation that psychologists and social scientists remained relatively mute in the public discussion about the peaceful uses of nuclear energy and the hazards involved for mankind. Did they really, or did the public just not listen to them. This question initiated the search for publications by experts in the two fields, and the present exhibition and relevant bibliographic material point to statements and other publications by well-known authors, showing the psychological and social aspects of the problem. The material covers citations, references, and supplementing texts from political or medical publications, and it becomes clear that there have been mechanisms of suppression that put aside many an important aspect. A bibliography of literature by social scientists is given. (HSCH).

51269 **(JAERI-M—88-082) User's manual of VARS: a computer code system for uncertainty analysis.** Ishigami, Tsutomu; Kobayashi, Kensuke; Horii, Hideo; Miyabe, Tadao; Take, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). May 1988. 75p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754571/JAW.

This report describes the user's manual of the computer code system VARS for the uncertainty analysis. The VARS code system calculates uncertainties in output data of a computer code caused by propagation of uncertainties in input data using a response surface method. The VARS code system consists of a group of computer codes which have the following function: determination of cases of computer run based on an orthogonal factorial design, analysis of variance, regression analysis, and Monte Carlo calculation based on the regression equation. The uncertainties in output data are obtained in terms of a probability density function and a cumulative function.

51270 **(Juel—2188) Retention and distribution of fission products in core and primary circuit of high temperature reactors under hypothetical accidental events.** Berger-Rossa, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.)). Mar 1988. 120p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754845/JAW.

The work describes the system and the development of a new computer programme 'SPTRAN' for simulation of behaviour of fission products in the core and the primary circuit of high temperature reactors with pebble bed core. The realized calcuation programmes are explained in detail. The range of application of the developed computer programme includes all conditions starting from normal operation and being of interest for safety analyses. The application of the computer programme is demonstrated at the example of the HTR-550. The accident scenario: 'Core heat up after fast pressure release of the primary circuit' is investigated. The thermohydraulic transients are investigated with the programme 'THERMIX' for the core and network range and are adapted to 'SPTRAN' over two interface programmes. Afterwards the transportation behaviour of Cs-137 is investigated and discussed in detail.

51271 **(NUREG—0822-Suppl.1) Integrated plant safety assessment: Systematic Evaluation Program: Oyster Creek Nuclear Generating Station: (Docket No. 50-219).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1988. 69p. NTIS, PC A04/MF A01 - GPO. Order Number TI88014915/JAW.

The US Nuclear Regulatory Commission (NRC) has prepared Supplement 1 to the final Integrated Plant Safety Assessment Report (IPSAR) (NUREG-0822), under the scope of the Systematic Evaluation Program (SEP), for the Oyster Creek Nuclear Gener-

ating Station, located in Ocean County, New Jersey, and operated by GPU Nuclear Corporation and Jersey Central Power and Light Company (colicensees). The SEP was initiated by the NRC to review the design of older operating nuclear power plants to reconfirm and document their safety. This report documents the review completed under SEP for those issues that required refined engineering evaluations or the continuation of ongoing evaluations subsequent to issuing the final IPSAR for the Oyster Creek plant. The review has provided for (1) an assessment of the significance of differences between current technical positions on selected safety issues and those that existed when the Oyster Creek plant was licensed, (2) a basis for deciding how these differences should be resolved in an integrated plant review, and (3) a documented evaluation of plant safety. The final IPSAR and its supplement will form part of the bases for considering the conversion of the existing provisional operating license to a full-term operating license. 4 refs., 1 tab.

51272 **(NUREG—1313) Safety evaluation report related to the evaluation of low-enriched uranium silicide-aluminum dispersion fuel for use in non-power reactors.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1988. 119p. NTIS, PC A10/MF A01 - GPO. Order Number TI88015541/JAW.

Low-enriched uranium silicide-aluminum dispersion plate-type fuels have been extensively researched and developed under the international program, Reduced Enrichment in Research and Test Reactors. The international effort was led by Argonne National Laboratory (ANL) in the United States. This evaluation is based primarily on reports issued by ANL that discuss and summarize the developmental tests and experiments, including postirradiation examinations, of both miniature and full-sized plates of prototypical fuel compositions. This evaluation concludes that plate-type fuels suitable and acceptable for use in research and test reactors can be fabricated with U_3Si_2-Al dispersion compacts with uranium densities up to 4.8 g/cm^3. 4 refs., 1 fig.

51273 **(NUREG/CR—4873) Benchmark study of the I-DYNEV evacuation time estimate computer code.** Urbanik, T. II; Moeller, M.P.; Barnes, K. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 39p. (PNL—6171). NTIS, PC A03/MF A01 - GPO. Order Number TI88014609/JAW.

This report compares observed vehicle movement on a highway network during periods of peak computer traffic with a simulation of the traffic flow made with the I-DYNEV computer model. The purpose of the comparison is to detemine if the model can accurately simulate the patterns of vehicular movement and delay during congested commuter traffic. The results indicate that the I-DYNEV model adequately simulates the pattens of vehicular movement and delay associated with an evacuation, provided that the model's capacity reduction factor is an input parameter. The current I-DYNEV model automatically reduces capacity by 15% of input capacity to account for congestion-induced losses in capacity reduction due to congestion, the model underestimated capacity during congestion. Therefore, the use of a capacity reduction factor should be a decision made by the analysts, not the model. When I-DYNEV was used with a capacity reduction factor appropriate to the data set used (i.e., no reduction in capacity), I-DYNEV produced reasonable results. 3 refs., 18 figs., 3 tabs.

51274 **(NUREG/CR—4920-Vol.3) Assessment of severe accident prevention and mitigation features: BWR, Mark III containment design.** Fitzpatrick, R.G.; Lehner, J.R.; Eltawila, F.; Perkins, K.R.; Luckas, W.J.; Pratt, W.T. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor and Plant Systems; Brookhaven National Lab., Upton, NY (USA)). Jul 1988. Contract AC02-76CH00016. 74p. (BNL-NUREG—52070-Vol.3). NTIS, PC A04/MF A01 - GPO. Order Number TI88014807/JAW.

Plant features and operator actions, which have been found to be important in either preventing or mitigating severe accidents in BWRs with Mark III containments (BWR Mark II's), have been identified. These features and actions were developed specifically for the Grand Gulf Plant and from assessments of other relevant studies. Accident sequences that dominate the core-damage frequency and those accident sequences that are of potentially high consequence were identified. Vulnerabilities of the BWR Mark III to severe accident containment loads were also identified. In addition, those features of a BWR Mark III, which are important for preventing core damage and are available for mitigating fission-product release to the environment were also identified. This report is issued to provide focus to an analyst examining an individual plant. The report calls attention to plant features and operator actions and provides a list of deterministic attributes for assessing those features and actions found to be helpful in reducing the overall risk for Grand Gulf and other Mark III plants. Thus, the guidance is offered as a resource in examining the subject plant to determine if the same, or similar, plant features and operator actions will be of value in reducing overall plant risk. This report is intended to serve solely as guidance.

51275 **(NUREG/CR—5043) Containment penetration system (CPS) tests under accident loads.** Crapo, H.S.; Steele R. Jr. (Nuclear Regulatory Commission, Washington, DC (USA); EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1988. Contract AC07-76ID01570. 72p. (EGG—2524). NTIS, PC A05/MF A01 - GPO. Order Number TI88016620/JAW.

This report provides the results of accident simulation tests of three typical light water reactor containment penetration systems to provide a technical basis for the support and development of equipment qualification procedures at design basis load levels and to determine safety margins at severe accident load levels. The three systems tested were (a) an 8-in. gate valve system modeling containment spray system; (b) an 8-in. butterfly valve system modeling a purge and vent system; and (c) a 2-in. globe valve system modeling the numerous small-bore piping systems. The valve types, valve sizes, piping configurations, penetrations, and supports used for the tests are typical of those found in commercial US nuclear power plants for containment isolation applications. The three systems tested were mounted in a fixture and exposed to simulated severe accident mechanical loads by displacing the penetrations relative to the piping. Thermal and pressure loads were also applied. The test results indicate that valve, penetration, or piping system failure during hypothesized accident even is unlikely due to accident-induced loads. 14 refs., 44 figs., 11 tabs.

51276 **(NUREG/CR—5071) TRAC [Transient Reactor Analysis Code] support software.** Jenks, R.P.; Martinez, V. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis; Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 104p. (LA—11214-MS). NTIS, PC A06/MF A01 - GPO. Order Number TI88013746/JAW.

This manual provides users of the Transient Reactor Analysis Code (TRAC) with information about computer codes that can be used to support their analysis efforts. These codes are collectively referred to as TRAC support software. Specifically, documentation is provided to allow users to implement, apply, and interpret the output of the support software that is available. The TRAC code is an advanced best-estimate code for analyzing transients in thermal-hydraulic systems. Considerable input data are required for modeling a large thermal-hydraulic system and considerable output data are produced from the computer calculation for analysis: the support software assists users in their management of both the input and the output data. The four codes described are central to the efficient and effective use of the TRAC code. EXCON is a TRAC graphics file postprocessor that converts the TRAC graphics output files into component-oriented input data files for use with TRAP. TRAP is an extensive plotting package that allows users to produce a range of plots from quick draft-quality graphs for fast examination of results to final presentation-quality graphics for more formal documentation requirements. Extract is a powerful support code that reads a TRAC dump file and generates "extracted information" for building TRAC input decks with the latest values for system conditions. EXTRACT is particularly useful and cost effective for analyses that require multiple parametric calculations. CVRT converts TRAC-PF1/MOD1 and early-version MOD2 input decks into current TRAC-PF1/MOD2 input decks.

51277 **(NUREG/CR—5126) TAC2D studies of Mark I containment drywell shell melt-through.** Weingardt, J.J.; Bergeron, K.D. (Nuclear Regulatory Commission, Washington, DC (USA); Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 68p. (SAND—88-1407). NTIS, PC A04/MF A01 - GPO. Order Number TI88016619/JAW.

A series of parametric calculations of the thermal attack of molten corium on a steel shell has been performed with the TAC2D computer code in order to elucidate uncertainties about the survivability of the BWR Mark I containment boundary in the event of a core-melt accident. Since TAC2D is a two-dimensional heat conduction code, it is not possible to capture some of the complexities of the corium spreading process or the debris-concrete interactions which would occur in this accident scenario. However, the two-dimensional transient nature of the thermal attack is modeled better with TAC2D than is possible with existing debris-concrete interaction codes. This study was therefore undertaken as a supplement to earlier work with debris-concrete interaction codes (like CORCON-MOD2), with the intention of assisting members of expert panels assessing uncertainty in severe accident phenomena for the US Nuclear Regulatory Commission's NUREG-1150 project. A total of 23 calculations are reported, consisting of two base cases (one with overlying water and one without) and numerous sensitivity variations about each case. Sensitivities investigated include mixed versus layered corium, heat transfer parameters upward and downward, initial corium temperature, chemical heating rate, heat transfer conditions in the gap outside the shell, and corium depth. 20 refs., 15 figs., 7 tabs.

51278 **(NUREG/CR—5141) Aging and qualification research on solenoid operated valves.** Bacanskas, V.P.; Toman, G.J.; Carfagno, S.P. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Franklin Research Center, Norristown, PA (USA). Valley Forge Corporate Center). Aug 1988. 176p. NTIS, PC A09 - GPO. Order Number TI88015392/JAW.

A research program was conducted on the aging and qualification of solenoid operated valves (SOVs) used in nuclear power generating stations. Tests were conducted on three-way, direct acting SOVs, manufactured by Automatic Switch Co. (ASCO) and Valcor Engineering Corp. Some SOVs had been aged naturally through service in nuclear power plants and others were subjected to accelerated aging. Thermal aging was conducted both with air and nitrogen as the process gas. Operational aging was simulated by putting the specimens through operational cycles at intervals during the accelerated thermal aging, with the environmental temperature controlled at a level representative of service conditions. The program also included simulation of a design basis event (DBE), that consisted of DBE gamma irradiation and a 30-d main steam line break/loss of coolant accident (MSLB/LOCA) simulation. After each major segment of the test program (aging, irradiation, and MSLB/LOCA simulation), some of the valve specimens were subjected to operational testing, then disassembled for inspection of all parts and measurement of physical properties (Shore A durometer hardness, elongation at break, and relaxation after compression) of the elastomeric parts.

51279 **(NUREG/CR—5164) A simplified model for calculating early offsite consequences from nuclear reactor accidents.** Madni, I.K.; Cazzoli, E.G.; Khatib-Rahbar, M. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA)). Jul 1988. Contract AC02-76CH00016. 170p. (BNL-NUREG—52153). NTIS, PC A08/MF A01 - GPO. Order Number TI88016973/JAW.

A personal computer-based model, SMART, has been developed that uses an integral approach for calculating early offsite consequences from nuclear reactor accidents. The solution procedure uses simplified meteorology and involves direct analytic integration of air concentration equations over time and position. This is different from the discretization approach currently used in the CRAC2 and MACCS codes. The SMART code is fast-running, thereby providing a valuable tool for sensitivity and uncertainty studies. The code was benchmarked against both MACCS version 1.4 and CRAC2. Results of benchmarking and detailed sensitivity/uncertainty analyses using SMART are presented. 34 refs., 21 figs., 24 tabs.

51280 **(NUREG/CR—5200) Evaluation of risks associated with AOT and STI requirements at the ANO-1 nuclear power plant.** Samanta, P.K.; Wong, S.M.; Carbonaro, J. (Brookhaven National Lab., Upton, NY (USA)). Aug 1988. Contract AC02-76CH00016. 76p. (BNL-NUREG—52024). NTIS, PC A05/MF A01 - GPO. Order Number TI88016971/JAW.

This report presents an evaluation of the core-melt frequency contributions associated with Allowed Outage Times (AOTs) and Surveillance Test Intervals (STIs) at Arkansas Nuclear One-Unit 1 (ANO-1). The results show that the core-melt frequency contributions from present AOTs and STIs vary by more than four orders of magnitude (a factor of 10,000). This wide range of variation indicates the wide range of the risk importance of present AOTs and STIs. The core-melt contributions from specific AOTs and STIs can be used to prioritize those components which should be focused on for inspection activities, personnel training, and reliability program activities that are involved with surveillanc testing and corrective maintenance. 10 refs., 11 figs., 41 tabs.

51281 **(PB—88-222757/XAB) Fire protection for power plants: past, present and future. Technical report.** Corcoran, J.R. (Niagara Mohawk Power Corp., Syracuse, NY (USA)). May 1985. 15p. NTIS, PC A03.

Major power stations are divided into two categories, fossil-fueled and nuclear. Fossil stations - coal, oil, natural gas, and dual fuel - are described as are the hazards and protective features unique to each type. Commonalities are highlighted and boiler controls, boiler auxiliaries, turbine-generator systems, electrical equipment and auxiliary systems are reviewed. The history of nuclear power stations, the impact of the Brown's Ferry fire and the resultant regulation by the Nuclear Regulatory Commission are discussed. The importance of utilizing fire protection engineers is underscored.

51282 **(RISO-M—2692-App.2) Final report of the Risoe monitoring programme after the Chernobyl accident for the period Oct 1, 1986 -Sept 30, 1987. Appendix 2. Chernobyl monitoring data compiled.** Aarkrog, A.; Nielsen, S.P.; Dahlgaard, H.; Lauridsen, B.; Soegaard-Hansen, J. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 112p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754487/JAW.

This appendix contains the detailed results of the Chernobyl monitoring programme carried out by Risoe from Oct 1, 1986 to Sept 30, 1987. 95 tabs., 10 ills.

51283 **(SAND—87-2520C) In-vessel reactor accident chemistry: Victoria models.** Grimley, A.J. III. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 25p. (CONF-8806143—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016527/JAW.

From 2. nuclear reactor severe accident chemistry symposium; Toronto, Canada (5 Jun 1988).

The VICTORIA code is designed to be a module of the MELPROG severe accident analysis code. The VICTORIA code is designed to model the in-vessel phase of a severe reactor accident. The functions of VICTORIA in MELPROG are fission product release from fuel, vapor-phase and aerosol physics, and chemical interactions involving fuel, structures, coolant, and aerosols. A stand-alone version of the code additionally provides independent capabilities for gaseous and aerosol transport within the coolant flow channel. this report discusses the VICTORIA code and the chemical models contained therein.

51284 **(WM-PD—88-003) Radioactive Waste Management Complex/Stored Waste Examination Pilot Plant (RWMC/SWEPP) programs training manual.** Watson, L.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1988. Contract AC07-76ID01570. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88015275/JAW.

This document presents the Training Program provided to Radioactive Waste Management Complex/Stored Waste Examination Pilot Plant (RWMC/SWEPP) personnel. This document is authorized by the RWMC/SWEPP Project Directive PD-RS-4.2 and is consistent with the EG&G Idaho, Inc., Waste Management objectives. To accommodate the various needs of the groups and projects comprising RWMC/SWEPP Programs, this document has been designed as an add-on manual and is divided into major sections. If any of the various groups or projects within the RWMC/SWEPP organization decide training is desirable, that group or project could generate the applicable training designed for their needs and incorporate it into this manual as required.

51285 **(NUREG/CR—2331←Vol.7-No.2-No.3) Safety research programs sponsored by Office of Nuclear Regulatory Research: Progress report, April 1-September 30, 1987.** Bari, R.A.; Boccio, J.L.; Carew, J.F.; Czajkowski, C.J.; Fitzpatrick, R.; Ginsberg, T.; Greene, G.A.; Guppy, J.G.; Hall, R.E.; Khatib-Rahbar, M.; Luckas, W.J. Jr.; Perkins, K.R.; Philippacopoulos, A.J.; Pratt, W.T.; Rohatgi, U.S.; Taylor, J.H.; van Tuyle, G.J.; Unwin, S.D.; Wulff, W.; Weiss, A.J. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA)). Jun 1988. Contract AC02-76CH00016. 267p. (BNL-NUREG—51454-Vol.7-No.2-No.3). NTIS, PC A12/MF A01 - GPO. Order Number TI88016972/JAW.

The Advanced and Water Reactor Safety Research Programs Quarterly Progress Reports have been combined and are included in this report entitled, "Safety Research Programs Sponsored by the Office of Nuclear Regulatory Research{endash}Progress Report." This progress report will describe current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the Division of Regulatory Applications, Division of Engineering, Division of Reactor Accident Analysis, and Division of Reactor and Plant Systems of the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research following the reorganization in February 1987. 38 refs., 82 figs., 26 tabs.

51286 **Investigation of time-step insensitivity for RELAP5/MOD2 SBLOCA simulations.** Makowitz, H.; Gray, W.H. *Transactions of the American Nuclear Society;* **55**: 363-364(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A systematic and comprehensive study of temporal and spatial convergence for thermal-hydraulic system simulation codes used for nuclear reactor analysis has not been performed to date. A study has been initiated investigating time-step sensitivity of the RELAP5/MOD2 nuclear reactor thermal-hydraulic simulation code for a small-break loss-of-coolant (SBLOCA) plant simulation, with spatial noding characteristic of high-fidelity calculations. A range of maximum allowed time step $\Delta t/sub\ max/$ of over three orders of magnitude has been used ($\Delta t/sub\ max/ = 0.01$, 0.125, and 2.0 s), for 200 s of simulation, using the semiimplicit. Courant limited numerical scheme. Understanding the spatial and temporal convergence properties of specific implementations of numerical schemes used for thermal-hydraulic nuclear reactor simulation is critical to developing high-fidelity mathematical models of nuclear systems. It is important to understand the sensitivity of calculations to time-step size since this influences uncertainty in code results, apart from that due to imprecision in the basic mathematical models. The authors have selected a SBLOCA problem for the study that has spatial noding characteristic of licensing audit calculations. Presently, only temporal accuracy and convergence of this SBLOCA simulation are being investigated.

51287 **Calculation of absorbed doses to water pools in severe accident sequences.** Weber, C.F. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 367-368(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The liberation of radioactive materials into various containment locations during a severe accident creates a radiation field that may have a significant impact on the accident progression. High radiation may not only impair the functioning of important equipment, but contributes directly to a higher source term. Recent experiments indicate the radiation in air may create significant quantities of nitric acid. Irradiation of acidic iodide solutions is known to produce more volatile iodine species (chiefly I_2 and CH_3I), which could evaporate and present a considerable threat to public health and safety. The process involves the formation of water radiolysis products (e.g., ions and free radicals), which subsequently react chemically with iodide. The Oak Ridge National Laboratory code TRENDS has been developed as a research tool to analyze the effects in severe accident sequences of such phenomena as gas phase iodine transport and radiolysis reactions. The purpose of this paper is to describe the methodology currently used for determining doses to sumps or water pools due to the decay of dissolved or suspended nuclides.

51288 **Dynamic analysis of the Chernobyl accident.** Toffer, H.; Twitchell, R.W. *Transactions of the American Nuclear Society;* **55**: 411-412(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

On April 26, 1986, the worst accident in the nuclear industry occurred at the Chernobyl Unit 4 reactor in the USSR. Initially, many causes were postulated for the accident; ultimately, a reactivity transient was identified as the driver for the power buildup leading to the core disruptive event. After the accident, the Hanford N-Reactor was put under close scrutiny to ascertain that a Chernobyl-type reactivity transient was not possible. Since UNC Nuclear Industries had specialized expertise in the analysis of graphite-moderated reactors, the company was requested to help identify the possible contributing factors leading to the Chernobyl transient. The support effort was in three areas: development of a three-dimensional model of the Russian reactor to establish flux and power distributions, lattice cell calculations to compute reactivity coefficients and to generate cross sections for static and dynamic analyses, and performance of dynamic calculations exploring the contribution of control rod action on the reactivity transient. As part of the flux-flattening program for the N-Reactor, the DELPHI code has been developed. This particular code solves the static diffusion equation for two energy groups in three dimensions. The code includes thermal-hydraulic feedback and burnup considerations. The basic code was modified, and the Chernobyl 4 reactor was modeled and evaluated. Useful information on flux distributions for subsequent analyses was obtained.

51289 **Metal-fuel modeling for inherently safe reactor designs.** Miles, K.J. Jr. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 417-418(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Current development of breeder reactor systems has led to the renewed interest in metal fuels. These fuels have properties that enhance the inherent safety of the system, such as high thermal conductivity, compatibility with liquid sodium, and low fuel/cladding mechanical interaction. While metal-fuel irradiation behavior is well understood, there are some areas where more information is needed to fully understand the various safety-related phenomena, such as fuel/cladding chemical interaction, eutectic melting and penetration, and axial relocation of molten fuel prior to cladding breach. Because many of these phenomena can cause changes in the reactivity state of the system, their effects on whole-core normal, anticipated, and hypothetical accident scenarios need to be studied. The metal-fuel behavior model DEFORM-5 is being developed to provide the necessary phenomenological basis for these studies. The first stage in the DEFORM-5 development has been completed. Presently, DEFORM-5 calculates the cladding strain, life fraction, and eutectic penetration thinning for Types D9, HT9, or 316 steels. This first stage of DEFORM-5 has been used to analyze the TREAT M2, M3, and M4 transients with irradiated Experimental Breeder Reactor-II driver fuel. The paper shows the DEFORM-5 and experimental results for failure times for the test pins. The results provide confidence and validation of the DEFORM-5 modeling of the cladding behavior.

51290 **First TREAT transient overpower tests on U-Pu-Zr fuel: M5 and M6.** Robinson, W.R.; Bauer, T.H.; Wright, A.E.; Rhodes, E.A.; Stanford, G.S.; Klickman, A.E. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 418(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Transient Reactor Test Facility (TREAT) tests M5 and M6 were the first transient overpower (TOP) test of the margin to cladding breach and prefailure elongation of metallic U-Pu-Zr ternary fuel, the reference fuel of the integral fast reactor concept. Similar tests on U-5 wt% Fs fueled Experimental Breeder Reactor (EBR)-II driver pins were previously performed and reported. Results from these earlier tests indicated a margin to failure of ~ 4 times nominal power and significant axial elongation prior to failure, a feature that was very pronounced at low burnups. While these two fuels types are similar in many respects, the ternary alloy exhibits a much more complex physical structure and is typically irradiated at much higher temperatures. Thus, a prime motivation for performing M5 and M6 was to compare the safety-related fuel performance characteristics of U-Fs and U-Pu-Zr. Tests M5 and M6 indicate that, under the TOP conditions used in the tests, ternary fuel displayed about the same margin to failure as U-Fs fuel. At low burnups, ternary fuel showed less prefailure axial elongation than observed in U-Fs pins, but elongations of 3 to 5% might turn out to be typical. Finally, fuel from the breached ternary pin in M6 showed, qualitatively, the same benignly dispersive behavior as U-Fs.

51291 **Initial pipe-break analyses for advanced LMR concepts using MINET.** Van Tuyle, G.J.; Chan, B.C.; Slovik, G.C. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 418-421(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In support of an initial US Nuclear Regulatory Commission review of US Dept. of Energy sponsored advanced liquid-metal reactors (LMRs), PRISM and SAFR, Brookhaven National Laboratory has performed some very conservative calculations of postulated primary loop pipe breaks using the MINET code. Both PRISM and SAFR are designed largely for inherent safety, based on natural circulation flow, high thermal conductivity, and generally passive systems. This initial study of possible breaks within the PRISM and SAFR primary circuits indicates that such breaks are not severe safety challenges to these designs.

51292 **SASSYS analysis of EBR-II SHRT experiments.** Hill, D.J. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 421-422(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The SASSYS-1 systems thermal-hydraulic code for LMRs has been applied to the analysis of selected EBR-II SHRT experiments. The results show that SASSYS can predict the transient thermal-hydraulic and reactivity behavior of EBR-II under these conditions. This contributes to the validation of the modeling of EBR-II with SASSYS and of the code itself. The next step is blind post-test analysis of the unprotected transients performed in EBR-II.

51293 **Evaluation of advanced liquid-metal-reactor passive air-cooling systems.** Kroeger, P.G.; Van Tuyle, G.J. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 422-423(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Both advanced liquid-metal-reactor (LMR) concepts (PRISM and SAFR) currently being proposed by the US Dept. of Energy include a passive air-cooling system for final decay heat removal under accident conditions. To be completely passive, these cooling systems are operative at all times, causing a minor parasitic energy loss during normal operation. In either concept, the heat rejection from the reactor vessel to the air-cooling system is by radiation and convection across a gas gap between the reactor vessel and the guard vessel, and by radiation from the guard vessel to the opposite air-cooling system surface (collector surface), and ultimately by convection from both surfaces to the rising air. An evaluation of the passive air-cooling system was performed with the PASCOL code, which was originally developed for analyzing a similar passive air-cooling system in the modular high-temperature gas-cooled reactor program. A comparison of results and the vendor's claimed performance for both concepts is shown. As can be seen, both systems can readily achieve the required decay heat removal rate. Further increases in performance could readily be achieved; however, such performance increases may not be desirable, since they would raise the parasitic heat losses under normal operating conditions.

51294 **Comparison of the SASSYS/SAS4A radial core expansion reactivity feedback model and the empirical correlation for the FFTF.** Wigeland, R.A. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 423-424(1987). (CONF-8711195—).

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The present emphasis on inherent safety for liquid-metal reactor designs has resulted in a need to represent the various reactivity feedback mechanisms as accurately as possible. The dominant negative reactivity feedback has been found to result from radial expansion of the core for most postulated anticipated transient without scram events. For this reasons, a more detailed model for calculating the reactivity feedback from radial core expansion, including subassembly bowing has been recently developed for use with the SASSYS/SAS4A code system. The purpose of this summary is to present an extension to the model so that it is more suitable for handling a core restraint design as used in the Fast Flux Test Facility (FFTF), and to compare the SASSYS/SAS4A results using this model to the empirical correlation presently being used to account for radial core expansion reactivity feedback in the FFTF.

51295 **Nuclear safety research at National Tsing-Hua University.** Pan, C.; Shih, C.; Pei, B.S. (National Tsing-Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 425(1987). (CONF-8711195—).

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Nuclear safety has recently been a major research area in the Dept. of Nuclear Engineering, National Tsing-Hua University (NTHU), Taiwan. Nine out of 26 faculty members devote themselves partly or fully to this area. Nuclear safety is the subject supported most heavily by the Atomic Energy Council (AEC), Taiwan Power Company (TPC), and the National Science Council. Major research activities in the field of nuclear safety include critical heat flux (CHF) correlations modifications, investigations of transition boiling heat transfer, plant transient analyses, severe accident analyses, and accident consequences evaluations.

51296 **Penn State advanced light water reactor concept.** Borkowski, J.A.; Smith, K.A.; Edwards, R.M.; Robinson, G.E.; Schultz, M.A.; Klevans, E.H. (Pennsylvania State Univ., University Park (USA)). *Transactions of the American Nuclear Society;* **55**: 426-427(1987). (CONF-8711195—).

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The accident at Three Mile Island heightened concerns over the safety of nuclear power. In response to these concerns, a research group at the Pennsylvania State University (Penn State) undertook the conceptual design of an advanced light water reactor (ALWR) under sponsorship of the US Dept. of Energy (DOE). The design builds on the literally hundreds of years worth of experience with light water reactor technology. The concept is a reconfigured pressurized water reactor (PWR) with the capability of being shut down to a safe condition simply by removing all ac power, both off-site and on-site. Using additional passively activated heat sinks and replacing the pressurizer with a pressurizing pump system, the concept essentially eliminates the concerns of core damage associated with a total station blackout. Evaluation of the Penn State ALWR concept has been conducted using the EPRI Modular Modeling System (MMS). Results show that a superior re-

sponse to normal operating transients can be achieved in comparison to the response with a conventional PWR pressurizer. The DOE-sponsored Penn State ALWR concept has evolved into a significant reconfiguration of a PWR leading to enhanced safety characteristics. The reconfiguration has touched a number of areas in overall plant design including a shutdown turbine in the secondary system, additional passively activated heat sinks, a unique primary side pressurizing concept, a low pressure cleanup system, reactor building layout, and a low power density core design.

51297 **Development of quantitative goals for inherent safety feature design and licensing.** Kastenberg, W.E.; Apostolakis, G.; Dhir, V.K.; Okrent, D. (Univ. of California, Los Angeles (USA)). *Transactions of the American Nuclear Society;* **55**: 427-428(1987). (CONF-8711195—).

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There is now considerable interest in the development of advanced fast reactors whose major focus is inherent safety. The achievement of inherent safety can be viewed from several aspects. In the Integral Fast Reactor Concept the approach is to utilize the intrinsic characteristics of pool-type liquid metal fast breeder reactors (LMFBRs) and the properties of metal fuels to integrate a high degree of inherent safety into the design. The PRISM and SAFR concepts focus on other inherent safety features. The reactors discussed above represent a radical departure from existing LWR designs as well as previous LMFBR designs (e.g., CRBRP) which are based, for the most part, on the General Design Criteria found in 10CFR50 Appendix. In view of these parallel developments (advanced reactors exploiting inherent safety and the use of quantitative goals to augment licensing), there appears to be a need to perform research on the development of methods for designing, assessing, and licensing inherent safety features in advanced reactors. The objectives of such research are outlined.

51298 **Total quality control: the deming management philosophy applied to nuclear power plants.** Heising, C.D.; Wetherell, D.L.; Melhem, S.A.; Sato, M. (Northeastern Univ., Boston, MA (USA)). *Transactions of the American Nuclear Society;* **55**: 429-430(1987). (CONF-8711195—).

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In recent years, a call has come for the development of inherently safe nuclear reactor systems that cannot have large-scale accidents. In the search for the perfect inherently safe reactor system, some are calling for the institution of computerized automated control of reactors eliminating most human operators from the control room. A different approach to the problem of the control of inherently safe reactors is that both future and present nuclear power plants need to institute total quality control (TQC) to plant operations and management. The Deming management philosophy of TQC has been implemented in a wide range of industries - particularly in Japan and the US. Specific attention is given, however, to TQC implementation in the electric power industry as applied to nuclear plants. The Kansai Electric Power Company and Florida Power and Light Company have recently implemented TQC. Statistical quality control methods have been applied to monitor and control reactor variables (for example, to the steam generator water level important to start-up operations of pressurized water reactors).

51299 **Parallel-signal-processing approach to signal validation.** Kerlin, T.W.; Upadhyaya, B.R.; Gloeckler, O.; Frei, Z.; Qualls, L.; Morgenstern, V. (Univ. of Tennessee, Knoxville (USA)). *Transactions of the American Nuclear Society;* **55**: 430-431(1987). (CONF-8711195—).

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Signal validation is the application of systematic on-line techniques to determine whether sensor outputs are correct. Because of the importance of signal validation in ensuring safe and efficient operation of nuclear power plants, active research programs are under way at several organizations in the US and abroad. The work reported here has been in progress since October 1986. Signal validation techniques involve in situ diagnostic tests on individual sensors and consistency checks among arrays of like or unlike sensors. Several different approaches have been developed by investigators working in this field. Since these techniques have different capabilities for detecting the various sensor anomalies that can occur, a new parallel-signal-processing approach is being implemented to exploit the potential of all existing and future methods. The system architecture that evolved in this project is shown. The signal processing channels currently under development for use in the system are described. The programming and checking of these algorithms various from 20 to 90% complete. Signal validation methods, when properly implemented, will improve the safety and efficient operation of current and future nuclear power plants. Some of the signal processing channels are also applicable to predictive maintenance and diagnostics.

51300 **System safety and reliability using object-oriented programming techniques.** Patterson-Hine, F.A.; Koen, B.V. (Univ. of Texas, Austin (USA)). *Transactions of the American Nuclear Society;* **55**: 431-432(1987). (CONF-8711195—).

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Direct evaluation fault tree codes have been written in recursive, list-processing computer languages such as PL/1 (PATREC-I) and LISP (PATREC-L). The pattern-matching strategy implemented in these codes has been used extensively in France to evaluate system reliability. Recent reviews of the risk management process suggest that a data base containing plant-specific information be integrated with a package of codes used for probabilistic risk assessment (PRA) to alleviate some of the difficulties that make a PRA so costly and time-intensive. A new programming paradigm, object-oriented programming, is uniquely suited for the development of such a software system. A knowledge base and fault tree evaluation algorithm, based on previous experience with PATREC-L, have been implemented using object-oriented techniques, resulting in a reliability assessment environment that is easy to develop, modify, and extend.

51301 **Aerosol material release rates from zircaloy-4 at temperatures from 2000 to 2200°C.** Mulpuru, S.R.; Wren, D.J.; Rondeau, R.K. *Transactions of the American Nuclear Society;* **55**: 433-434(1987). (CONF-8711195—).

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During some postulated severe accidents involving loss of coolant and loss of emergency coolant injection, the temperatures in a CANDU reactor fuel channel become high enough to cause failure and melting of the Zircaloy fuel cladding. At such high temperatures, vapors of fission products and structural (fuel and cladding) materials will be released into the coolant steam and hydrogen mixture. These vapors will condense as cooler conditions are encountered downstream. The vapors from structural materials are relatively involatile; therefore, they will condense readily into aerosol particles. These particles, in turn, will provide sites for the condensation of the more volatile fission products. The aerosol transport of fission products in the primary heat transport system (PHTS) will thus be influenced by the structural material release rates. As part of an ongoing program to develop predictive tools for aerosol and associated fission product transport through the PHTS, experiments have been conducted to measure the vapor mass release rates of the alloying elements from Zircaloy-4 at high temperatures. The paper presents the results and analysis of these experiments.

51302 **Characteristics of releases from TREAT source term experiment STEP-3.** Fink, J.K.; Schlenger, B.J.; Baker, L. Jr.; Ritzman, R.L. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 434-435(1987). (CONF-8711195—).

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Four in-pile experiments designed to characterize the radiological source term associated with postulated severe light water reactor accidents were performed at the Transient Reactor Test Facility. STEP-3 simulated a high-pressure TMLB' pressurized water reactor accident sequence that includes the extended loss of all ac power and leads to the loss of long-term decay heat removal. In STEP-3, four fuel elements from the Belgonucleaire BR3 reactor were subjected to temperature and pressures approaching those of a

TMLB' accident. A description of the experiment and thermal-hydraulic analysis is reported elsewhere. The aerosols released into the flow stream were collected on coupons, settling plates, and wire impactors. Examination of the collected aerosol deposits was performed using scanning electron microscopy, electron microprobe microanalysis, and secondary ion mass spectroscopy (SIMS), to provide information about the chemical composition and morphology of the release. This paper describes the aerosol deposits and elemental composition of the release.

51303 **Source-term experiment STEP-3 simulating a PWR severe station blackout.** Simms, R.; Baker, L. Jr.; Ritzman, R.L. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 435-436(1987). (CONF-8711195—).

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For a severe pressurized water reactor accident that leads to a loss of feedwater to the stream generators, such as might occur in a station blackout, fission product decay heating causes a water boil-off. Without effective decay heat removal, the fuel elements will be uncovered. Eventually, steam will oxidize the overheated cladding. The noble gases and volatile fission products, such as cesium and iodine, that are major contributors to the radiological source term will be released from the damaged fuel shortly after cladding failure. The accident environment when these volatile fission products escape was simulated in STEP-3 using four fuel elements from the Belgonucleaire BR3 reactor. The primary objective was to examine the releases in samples collected as close to the test zone as possible. In this paper, an analysis of the temperatures and hydrogen generation is compared with the measurements. The analysis is needed to estimate releases and characterize conditions at the source for studies of fission product transport.

51304 **Burst calculations for a fission product release experiment.** Sdouz, G. (Austrian Research Center, Seibersdorf (Austria)). *Transactions of the American Nuclear Society;* **55**: 437-438(1987). (CONF-8711195—).

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Experiment LP-FP-1 was conducted in the loss-of-fluid test (LOFT) facility to determine the fission product release from the fuel-cladding gap and the transport of the fission products in the primary coolant system. During the test, the cladding temperatures increased, and finally 8 of the 22 fuel rods in the center fuel assembly ruptured and released fission products. To analyze the experiment and to check the capability of the computer codes, post-test calculations were performed. The goal of this work was the determination of the burst data, as time and location of burst and cladding temperatures at burst. The calculation was carried out using the BALO-2A code.

51305 **CORCON-MOD2 modeling of Kuosheng - metal contents sensitivity analysis.** Liao, I.C.; Shih, C. (National Tsing-Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 438-439(1987). (CONF-8711195—).

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In this paper, the authors summarize sensitivity analysis of zirconium and steel in the CORCON-MOD2 modeling for Kuosheng, a boiling water reactor-6 MARK-III nuclear power plant near Taipei. Conclusions are presented, and associated physical processes as discovered from the CORCON outputs are discussed.

51306 **Kuosheng small-break LOCA analysis using MAAP2.0 and MAAP3.0 codes.** Chen, S.R.; Wang, T.K.; Chieng, C.C.; Wang, C.C. (National Tsing-Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 439-440(1987). (CONF-8711195—).

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This paper reports on a small-break loss-of-coolant accident (LOCA) analysis for Taipower's Kuosheng Unit 1 plant. The target plant is a boiling water reactor-6/MARK III design with a rated power of 2895 MW(thermal). The event sequences were first analyzed using the MAAP2.0 and MAAP3.0 codes. Detailed phenomena pertaining to burnings and containment failure were studied through varying values of two input parameters, TZOOFF and TCFLAM, in MAAP2.0. The major differences between these two versions of the MAAP code are in the description of the primary system, core melt model, H_2 burning mode, and fission product transport mechanism. In both versions, the Mark III containment areas include pedestal cavity, dry well, wet well, compartment A, and compartment B (the dome area).

51307 **Analysis of risk-dominant sequences by MAAP3.0 for Kuosheng Nuclear Power Plant.** Lin, J.D.; Chieng, C.C.; Wang, T.K.; Hsiue, R.K. (National Tsing-Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 440-441(1987). (CONF-8711195—).

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Kuosheng Nuclear Power Plant is the first operating model-6/Mark III boiling water reactor (BWR6/Mark III) in the world, and a probabilistic risk assessment (PRA) has been performed to determine the likely frequencies of core melt accidents and the magnitude, composition, and fraction of fission products released in these accidents. The final report of this PRA indicates that categories 8 and 15 are ranked No. 1 by risk index (the product of release frequency and release fraction) and release frequency, respectively. The dominant contributors of these two categories are frequent earthquakes and typhoons.

51308 **Comparative study of STCP and SCDAP simulation of PBF SFD test 1-1.** Yang, J.W.; Khatib-Rahbar, M. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 441-442(1987). (CONF-8711195—).

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Over the last decade, there has been substantial development and progress in understanding the nature of severe accidents in light water reactors. Of particular interest is being able to predict the fission product release and transport after the reactor core is damaged. As part of this continuing effort, the US Nuclear Regulatory Commission sponsored the development of the Source Term Code Package (STCP), which models core degradation and fission product release to the environment. In order to better establish the validity of source term predictions from these phenomenological models, extensive benchmarking against experimental data and more detailed mechanistic models are necessary. The purpose of this paper is to present the results of a detailed comparison of the STCP and the SCDAP computer codes for simulation of the Power Burst Facility (PBF) Severe Fuel Damage (SFD) test 1-1. The SCDAP code is mechanistic and has been benchmarked against a broad range of severe accident data. The SFD 1-1 test was designed to simulate the heatup and resulting fuel damage in the upper half of a 3000-MW(thermal) pressurized water reactor core $\sim$ 2 to 3 h after initiation of a small-break accident when the core is $\sim$ 75% uncovered.

51309 **Explicit time-dependent analysis in Monte Carlo reliability simulations.** Lewis, E.E.; Tu, Z.; Hald, U.P.; Boehm, F. (Northwestern Univ., Chicago, IL (USA)). *Transactions of the American Nuclear Society;* **55**: 443-444(1987). (CONF-8711195—).

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Markov Monte Carlo methods have been employed for estimating reliability and availability of highly redundant systems with complex dependencies between component failure rates. There is, however, a major drawback with such Monte Carlo simulation when compared with analytical solutions or the numerical integration of the Markov equations. The result of a Monte Carlo simulation is a single number, the mission unreliability or unavailability (and an associated confidence interval). In contrast, deterministic methods provide curves of unreliability or unavailability versus time, allowing time-dependent trends to be observed and permitting a better and more general picture of system behavior to be obtained. To alleviate this drawback the authors have developed graphic algorithms that allow one to plot system unreliability and/or unavailability and the associated confidence intervals versus mission time. The procedures, moreover, add $<$ 10% to the computa-

tion time required for a single Monte Carlo simulation to the maximum mission time to be considered.

51310 **Emergency operator support system using success paths and risk importance rules.** Kim, T.W.; Han, S.H.; Yoo, K.J. *Transactions of the American Nuclear Society;* **55**: 444(1987). (CONF-8711195—).

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This paper describes a system developed to aid plant operators in transients. To minimize the release of radioactive materials to the environment, nuclear power plants are designed with the concept of defense in depth; therefore, there are redundant paths to recover the plant in transients. The computer-aided system discussed here generates success paths and ranks these paths by risk importance rules. The concept of success paths is the contrary concept of minimal cut sets used in fault-tree analysis in probabilistic risk assessment. That is, this is a sequence that will allow a safety system to function successfully should some components fail.

51311 **Study on human factors related to BWR plant safety.** Itoh, J.I.; Ohtsuka, T.; Okehara, J.Y.; Yamada, K. *Transactions of the American Nuclear Society;* **55**: 445-446(1987). (CONF-8711195—).

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This summary presents the results of a study on human errors in simulated nuclear power plant operation. It has been recognized that the data on human factors during plant emergency situations are scarce despite their importance in assessing the operational safety of a nuclear power plant. The objectives of this study are to collect and analyze human factors data on nuclear power plant operation and to evaluate the human factors effects on probabilistic safety analysis. In this context, data on operator performance during reactor transients and accident conditions were collected using training simulators and analyzed to estimate human error probabilities. A tentative estimate of error rates was obtained.

51312 **Design of Korean nuclear reliability data-base network using a two-stage Bayesian concept.** Kim, T.W.; Jeong, K.S.; Chae, S.K. *Transactions of the American Nuclear Society;* **55**: 446-447(1987). (CONF-8711195—).

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In an analysis of probabilistic risk, safety, and reliability of a nuclear power plant, the reliability data base (DB) must be established first. As the importance of the reliability data base increases, event reporting systems such as the US Nuclear Regulatory Commission's Licensee Event Report and the International Atomic Energy Agency's Incident Reporting System have been developed. In Korea, however, the systematic reliability data base is not yet available. Therefore, foreign data bases have been directly quoted in reliability analyses of Korean plants. In order to develop a reliability data base for Korean plants, the problem is which methodology is to be used, and the application limits of the selected method must be solved and clarified. After starting the commercial operation of Korea Nuclear Unit-1 (KNU-1) in 1978, six nuclear power plants have begun operation. Of these, only KNU-3 is a Canada Deuterium Uranium pressurized heavy-water reactor, and the others are all pressurized water reactors. This paper describes the proposed reliability data-base network (KNRDS) for Korean nuclear power plants in the context of two-stage Bayesian (TSB) procedure of Kaplan. It describes the concept of TSB to obtain the Korean-specific plant reliability data base, which is updated with the incorporation of both the reported generic reliability data and the operation experiences of similar plants.

51313 **Results and insights from the Brunswick plant PRA.** Emerson, F.A.; Eide, S.A. *Transactions of the American Nuclear Society;* **55**: 447-449(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A level-2 probabilistic risk assessment (PRA) is being performed for Brunswick Plant Units 1 and 2. Both units are boiling water reactor (BWR)-4s with Mark I containments. Results of the level 1 portion are summarized in this paper. The total CDF estimates (resulting from internal events) for units 1 and 2 are 4.4 x 10^{-5}/yr and 3.4 x 10^{-5}/yr, respectively. The small variation between units is the result of minor differences in design and unit-specific operational histories. A breakdown of the total CDF into accident types is shown. Complete eternal analysis results are not yet available. Internal flooding contributes $< 10\%$ to the overall CDF. A detailed analysis of fire contributors to CDF is in progress. Further analysis of the seismic hazard curve and certain component seismic fragilities are planned. Containment analysis results also are not yet final.

51314 **Development of the integrated system reliability analysis code MODULE.** Han, S.H.; Yoo, K.J.; Kim, T.W. *Transactions of the American Nuclear Society;* **55**: 449-450(1987). (CONF-8711195—).

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The major components in a system reliability analysis are the determination of cut sets, importance measure, and uncertainty analysis. Various computer codes have been used for these purposes. For example, SETS and FTAP are used to determine cut sets; Importance for importance calculations; and Sample, CONINT, and MOCUP for uncertainty analysis. There have been problems when the codes run each other and the input and output are not linked, which could result in errors when preparing input for each code. The code MODULE was developed to carry out the above calculations simultaneously without linking input and outputs to other codes. MODULE can also prepare input for SETS for the case of a large fault tree that cannot be handled by MODULE. The flow diagram of the MODULE code is shown. To verify the MODULE code, two examples are selected and the results and computation times are compared with those of SETS, FTAP, CONINT, and MOCUP on both Cyber 170-875 and IBM PC/AT. Two examples are fault trees of the auxiliary feedwater system (AFWS) of Korea Nuclear Units (KNU)-1 and -2, which have 54 gates and 115 events, 39 gates and 92 events, respectively. The MODULE code has the advantage that it can calculate the cut sets, importances, and uncertainties in a single run with little increase in computing time over other codes and that it can be used in personal computers.

51315 **Brunswick plant containment structural analysis.** Emerson, F.A.; Toland, R. *Transactions of the American Nuclear Society;* **55**: 450-452(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

As part of the Brunswick Plant level-2 probabilistic risk assessment, an analysis of the containment structural response to core melt phenomena was conducted. The purpose of this paper is to describe the methodology, results, and conclusions of this analysis. The Brunswick Plant containments are unique among Mark I containments in that the construction of both the drywell and the torus for both units is reinforced concrete with a steel liner. This study is a significant advance in understanding the structural response of Mark I containments to severe accidents. The integration of penetration, seal, and hatch response into pressure vessel analysis, evaluation of response to several temperature/pressure profiles, and consideration of leakage compared to structural failure modes, combine to provide a comprehensive assessment of structural response. The structural failure pressure for the Brunswick Plant containments compares favorably with that calculated for more conventional steel shell Mark I containments.

51316 **Analysis of loss of off-site power with a PWR at shutdown.** Chu, T.L.; Yoon, W.H.; Fitzpatrick, R.G. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 452-453(1987). (CONF-8711195—).

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In many probabilistic risk assessments (PRAs), loss of offsite power (LOOP) when a nuclear power plant is operating was found to be a significant contributor to core damage. The purpose of this study is to provide an analysis of a LOOP event that occurs while a pressurized water reactor (PWR) is shut down. The importance of such an analysis was recognized as part of a study to evaluate the core damage frequency due to a loss of decay heat removal

(DHR) capability during an outage. When a PWR is in a shutdown condition, there are relatively few technical specification requirements on the operability of safety systems. In fact, some safety systems are intentionally disabled, i.e., the safety injection system and nonoperating charging pumps. Another problem when the reactor is shut down is that the reactor coolant system (RCS) may be partially drained and the steam generators may be unavailable. To determine the time available for operator actions, given that a LOOP occurs during shutdown and the DHR capability is lost, a simple thermal model has been developed. Similar calculations have been performed for other phases of refueling and maintenance outages. A total core damage frequency due to LOOP while the plant is in shutdown has been calculated to be 5.9 x 10^{-6}/yr. This is approximately twice the core damage frequency calculated for LOOP when the plant is at power.

51317 **RELAP5/MOD2 simulation of ORNL reflood tests.** Hassan, Y.A.; Henson, G.C. (Texas A & M Univ., College Station (USA)). *Transactions of the American Nuclear Society;* **55**: 454-456(1987). (CONF-8711195—).

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Following the blowdown phase of a postulated loss-of-coolant accident in a pressurized water reactor (PWR), the reactor core is uncovered and the fuel rods experience rapid temperature excursions because of decay power production and low heat transfer. In order to prevent fuel from overheating, emergency core cooling is activated and the accident enters the reflood phase. Several experimental and analytical programs have been performed to investigate the reflooding phenomena. The purpose of this study is to simulate several reflooding tests performed at Oak Ridge National Laboratory in the Thermal-Hydraulic Test Facility (THTF) using the latest version of RELAP5/MOD2 (cycle 36.04) to assess its capabilities in predicting the reflood phenomena. The code has demonstrated the capability to predict experimental behavior; however, refinements in the interfacial drag are required to improve the code's predictions.

51318 **Assessment of WCOBRA/TRAC with ORNL dispersed-flow film-boiling experiments.** Tsai, C.K. *Transactions of the American Nuclear Society;* **55**: 456-458(1987). (CONF-8711195—).

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Dispersed-flow film-boiling is an important phenomenon in a postulated nuclear reactor loss-of-coolant accident (LOCA). Several experiments have been performed to investigate the location of critical heat flux (CHF) and the resulting post-CHF heat transfer. The experimental data provide necessary information to evaluate the accuracy of the predictions of a computer code. For LOCA analysis, the central issue, of course, is the prediction of fuel rod cladding temperature. The WCOBRA/TRAC code, developed from COBRA/TRAC for analysis of nuclear reactor vessel and primary loop two-phase transients, is being used as a best-estimate model for LOCA licensing calculations at Westinghouse Electric Corporation. The code employs a two-fluid three-field (liquid, vapor, and droplet) model to represent a two-phase flow, which is necessary in simulating dispersed-flow film-boiling phenomena. Each field is treated as three-dimensional and compressible. The conservation equations for each field and the heat transfer from and within the solid structures in contact with the fluid are solved using a semiimplicit finite difference numerical scheme in Eulerian mesh structure. The noding scheme is very flexible and can be used to model complicated geometry.

51319 **Westinghouse best-estimate LOCA analysis model: WCOBRA/TRAC.** Hochreiter, L.E.; Schwarz, W.R.; Takeuchi, K.; Tsai, C.K.; Young, M.Y. *Transactions of the American Nuclear Society;* **55**: 458-459(1987). (CONF-8711195—).

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A rule change for 10CFR50.46 and Appendix K has been proposed by the US Nuclear Regulatory Commission (NRC). This change would allow the use of realistic (best-estimate) thermal-hydraulic computer codes to predict the emergency core cooling system performance for a postulated large-break loss-of-coolant accident (LOCA). The NRC staff expects that the analytical techniques used for predicting the design-basis large-break LOCA, will use realistic thermal-hydraulic models and will be based on applicable experimental data. WCOBRA/TRAC is a three-dimensional separated flow code that models the two-phase flow with three component fields: vapor phase, continuous liquid phase, and entrained liquid. The formulation of the governing equations is complete and includes turbulence models for the continuous phase. There is one continuity equation for each field, three momentum equations for each field (total of 9), and two energy equations. WCOBRA/TRAC meets the requirements for a realistic thermal-hydraulic model, which can be used to accurately predict postulated accident transients for a pressurized water reactor.

51320 **Prediction of pressure tube integrity for a large LOCA in CANDU.** Gulshani, P. *Transactions of the American Nuclear Society;* **55**: 459-461(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The core of a Canada deuterium uranium (CANDU) reactor consists of a large number of horizontal pressure tube fuel channels connected by individual feeder pipes to common horizontal headers above the core. Each pressure tube contains 37-element fuel bundles and is enclosed by a concentric calandria tube. The annular gap between the pressure tube and the calandria tube is filled with gas. The calandria tubes are surrounded by a heavy-water moderator. The pressure tubes provide a pressure boundary between the high-pressure primary heat transport system and the low-pressure, relatively cold moderator system. In a number of postulated accident scenarios, some of the fuel channels at decay power levels are predicted to experience periods of low flow. In such a period, the coolant boils and stratifies, exposing the upper fuel elements and the upper part of the pressure tube to superheated steam. The exposed fuel elements and the surrounding pressure tube then heat up. At sufficiently high tube temperature and channel pressure, the pressure tube may strain radially into contact with the relatively cold calandria tube, transferring its stored heat to the moderator. Stratified channel coolant conditions and falling channel water level, however, may cause temperature gradients to develop around the pressure tube circumference from peak temperatures at the top of the tube to the saturation temperature at water level. To predict the temperature distribution around the pressure tube circumference under stratified channel coolant conditions, a model named AMPTRACT was developed.

51321 **Prediction of pressure tube integrity for a small LOCA and total loss of emergency coolant injection in CANDU.** Gulshani, P. *Transactions of the American Nuclear Society;* **55**: 461-464(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

For an assumed low probability accident scenario of small inlet header break with loss of forced circulation, failure to depressurize the steam generators, and loss of emergency coolant injection (LOECI) in Canada deuterium uranium (CANDU) heat transport circuit, the primary circuit pressure remains high and the primary flow decreases. Eventually, the inlet headers receive a two-phase fluid. The fluid in the headers then stratifies extensively such that any given feeder can be considered to receive steam only. Subsequently, the water in this feeder begins to drain into the fuel channel. Under these low flow and decay power conditions, the coolant in the fuel channel boils and stratifies causing the pressure tube to heat up and develop temperature gradients around its circumference. A hydraulic model for a header-fuel channel-header assembly was developed to predict the channel water level and steam flow rate transients for the feeder draining scenario. The model (dubbed TALSMALL for TrAnsient Level SMAll LOCA/LOECI) uses the header boundary conditions obtained from a circuit calculation for the accident scenario. It is concluded that, for the assumed conditions of the accident scenario considered, the pressure tube will not rupture. Thus, for the assumed conditions of this severe accident scenario, pressure tube and channel integrity is preserved and the decay heat is removed by the moderator.

51322 **RELAP5YA simulation of LOFT small-break experiments L3-6 and L5-1.** Schor, L.; Harvey, R.C. *Transactions of the American Nuclear Society;* **55**: 464-465(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The loss-of-fluid test (LOFT) small-break tests were simulated using the RELAP5YA computer code at Yankee Atomic Electric Company (YAEC) as part of the integral code assessment program. RELAP5YA was developed at YAEC from RELAP5/MOD1 to provide a method for licensing analysis for small-break loss-of-coolant accidents (SBLOCAs) in pressurized water reactors (PWRs). The LOFT facility is a 50-MW(thermal) volumetrically scaled PWR that has been designed to simulate the significant thermal-hydraulic events expected in a commercial PWR during postulated LOCAs. The tests selected for this assessment were LOFT tests L3-6/L8-1 and L5-1. The present RELAP5YA model of the LOFT facility consists of 99 volumes, 105 junctions, and 59 heat slabs and includes all the necessary components (e.g., pumps and valves) and control systems (e.g., trip logic and pressure regulating valves) to provide an accurate simulation of the test sequence. These comparisons of the calculated and measured data for the LOFT small-break tests indicate that RELAP5YA generally matched important safety-related phenomena, such as system depressurization, primary coolant mass inventory, and core heatup and quench. The benchmarking results are currently being employed at YAEC to direct RELAP5YA modeling improvements for PWR SBLOCA applications.

51323 **Simulation of a loss-of-coolant accident in a WWER reactor - an IAEA standard problem exercise.** Almeida, C.; Szabados, L. *Transactions of the American Nuclear Society;* **55**: 465-466(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In order to enlarge the experimental data base for code assessment, the International Atomic Energy Agency (IAEA), in cooperation with the Central Research Institute for Physics of the Hungarian Academy of Sciences, has organized a standard problem exercise involving the simulation of a loss-of-coolant accident (LOCA) in the PMK-NVH experimental facility, a scaled-down model of a WWER-440 nuclear power plant. This paper presents a description of the facility and the test and summarizes the conclusions of the intercomparison of results provided by the 17 participants in pretest and post-test calculations.

51324 **Emergency cooling experiments with aqueous boric acid solution in the REWET-II facility.** Kervinen, T.; Tuunanen, J. *Transactions of the American Nuclear Society;* **55**: 466-467(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Although boron is widely used as soluble neutron poison in nuclear reactors (boric acid in pressurized water reactors, sodium pentaborate in boiling water reactors), there is a lack of experimental data about aqueous boron solution behavior during loss-of-coolant accidents. The main aims of the REWET boric acid experiments were to study the behavior of aqueous boric acid solution during long-term cooling of a nuclear reactor and to find out the circumstances in which boric acid crystallization takes place. In the experiments, carried out in the facility of a 19-fuel-rod simulator bundle, boric acid crystallization caused the uncovering of the bundle, which always occurred on the water surface. However, crossflows and backflows in a reactor presumably make the concentrations uniform and thus retard crystallization. Therefore, experimental investigations of aqueous boric acid solution behavior will be carried out for the next 2 yr in a larger scale experimental facility. The new facility will be a simulator of the Loviisa VVER-440 reactor with a scaling factor of 1:349 for power and volumes and 1:1 for elevations. The facility will contain a full-scale rod bundle.

51325 **Analysis of the Mannshan Unit 2 full load rejection transient.** Kang, J.C.; Pei, B.S.; Yu, G.P.; Yuann, R.Y. (National Tsing-Hua Univ. (Taiwan)). *Transactions of the American Nuclear Society;* **55**: 468-470(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Mannshan Unit 2 is a Westinghouse three-loop pressurized water reactor with a rated core power of 2775 MW(thermal) and a rated core flow of 4702 kg/s. Before full power operation, a planned net load rejection was performed during the startup test by opening the main transformer highside breakers. The generator power rapidly reduced to station load. All 16 steam dump valves immediately popped open, and control bank-D rods automatically stepped in as the temperature difference T/sub avg/ - T/sub ref/ reached a programmed 2.8°C. Nuclear power decreased smoothly as control rods were inserted into the core. The pressurizer pressure and liquid levels also dropped. Neither safety injection nor reactor trip occurred during this transient. The test was done to verify that the whole system would function properly under a transient to keep the reactor from scramming and that the vessel integrity would also be protected. In this study, which is the preliminary stage of RELAP5/MOD2 transient simulation of the Mannshan PWR plants, system thermal-hydraulic response is tested first and isolated from the neutronic effects. The variation of core power versus time curve was extracted from the power test data to serve as a time varying boundary condition. The comparison of the analytical results of four major parameters (pressurizer pressure, average temperature of the core, steam dump flow rate, and feedwater flow rate) from RELAP5/MOD2 and the power test data is illustrated.

51326 **Analysis of loss of off-site power ATWS in VVER-440 concept.** Hoeppner, G.; Siltanen, P.; Kotro, J. *Transactions of the American Nuclear Society;* **55**: 470-472(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

During 1985 the Finnish state-owned utility Imatran Voima Oy signed a work order with Gesellschaft fuer Reaktorsicherheit mbH of the Federal Republic of Germany (GRS) for the analysis of abnormal transients in a pressurized water reactor (PWR) concept based on a Soviet design. The results of these calculations were intended to be introduced into the licensing process and to support a decision to build such a nuclear power station. A computer model was constructed of the VVER-440 concept, a 500-MW(electric) PWR designed in the USSR and modified for Finland. The ALMOD4 code, developed at GRS, was used for the investigation. The ALMOD4 code is a fast running code for the analysis of operational and abnormal transients in PWRs. Input data were set up to calculate anticipated transients without scram, most notably the loss of off-site power case. One-dimensional neutron kinetics was used to correctly model the neutronics feedback of axially distributed moderator density and fuel temperature in a changing axial power profile. Interlocking signals and the engineered safety systems were modeled to assess the overall systems response to this abnormal transient. Special analytical problems were encountered since a detailed and verified model of the steam generator (SG) with horizontally positioned heat exchanger tubes was not available. Therefore, two bounding calculations were performed with different SG models.

51327 **Calculation of MCPR for BWR transients using the BNL plant analyzer.** Horak, W.C.; Diamond, D.J. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 472-474(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A class of transients of interest includes those from full power that involve some changes from the plant's technical specifications. These changes are allowed if it can be demonstrated that the effect on key parameters, such as the minimum critical power ratio (MCPR), is acceptable. Another class of transients is of interest for similar reasons, those that are initiated from the maximum extended operating domain (MEOD) or with partial feedwater heating. In the MEOD, the reactor conditions may be different from previous experience to increase the speed of the power ascension or obtain more power out of the core at end-of-cycle when the reactivity of the fuel is low. The critical power ratio (CPR) is used to determine the thermal limits of boiling water reactors (BWRs).

In this study, CPRs for a series of transients run on the Brookhaven Plant Analyzer (BPA) have been calculated. The transients include nominal base case simulations; simulations with variations in relief valve setpoints and the number of failed feedwater heaters; simulations at the 100% power, 75% flow point on the extended load line of the MEOD; and a simulation with partial feedwater heating. The plant represented with the BPA is a BWR/4 rated at 3293 MW with a 6.38-m vessel.

51328 **Evaluation of BWROG EPG level/power control strategy for Vermont Yankee.** Chandola, V.; Robichaud, J.D. *Transactions of the American Nuclear Society;* **55**: 474-475(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The current Boiling Water Reactor Owner's Group (BWROG) emergency procedure guidelines (EPGs) direct reactor operators to manually lower the reactor pressure vessel (RPV) water level to the top of active fuel (TAF) during an anticipated transient without scram (ATWS) event. Lowering the water level reduces the core inlet flow, thereby reducing core power. However, reducing water level is contrary to current operator training, which requires that normal RPV water level be maintained to assure core cooling. In addition, the indicated water level near TAF using cold calibrated level instrumentation may not be reliable, which could potentially result in uncovering the core. This paper evaluates the EPGs' level/power control strategy for the Vermont Yankee plant and proposes alternative to the BWROG guidelines as applied to ATWS response.

51329 **Effect of reactor conditions on MSIV-ATWS power level.** Diamond, D.J. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 475-476(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In a boiling water reactor (BWR) when there is closure of the main steam isolation valves (MSIVs), the energy generated in the core will be transferred to the pressure suppression pool (PSP) via steam that flows out of the relief valves. The pool has limited capacity as a heat sink and hence, if there is no reactor trip [an anticipated transient without scram (ATWS) event], there is the possibility that the pool temperature may rise beyond acceptable limits. The present study was undertaken to determine how the initial reactor conditions affect the power level during an MSIV-ATWS event. The time of interest is the 20- to 30-min period when it is assumed that the reactor is in a quasi equilibrium condition with the water level and pressure fixed, natural circulation conditions and no control rod movement or significant boron in the core. The initial conditions of interest are the time of the cycle and the operating state.

51330 **Natural circulation cooling following main steam line break outside containment.** Tsai, S.S.; Scobel, J.H.; Sloane, B.D.; Liparulo, N.J.; Bevard, D.G.; DeVault, R.M.; Bryan, R.H. Jr. *Transactions of the American Nuclear Society;* **55**: 476-477(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The US Nuclear Regulatory Commission (NRC) informed licensees of a potential problem related to the release of superheated steam following a postulated main steam line break. Mass and energy releases that consider the potential for superheated steam release have recently been calculated by Westinghouse for utility members of the Westinghouse Owners Group High Energy Line Break/Superheated Blowdowns Outside Containment (HELB/SBOC) Subgroup, and for utilities that requested plant specific analysis. Westinghouse was the first to discover the importance of the natural circulation cooling phenomenon during main steam line breaks with superheat release and confirmed the existence of natural circulation cooling outside containment by use of the Westinghouse COMPACT containment code. The code has many unique features, notably the natural circulation model that promotes better compartment mixing and provides additional cooling to the equipment exposed to superheated steam. Extensive code verification has been performed for COMPACT. COMPACT has been verified against the Carolinas Virginia Tube Reactor tests and other Westinghouse containment codes approved by the NRC.

51331 **Observations on hydrogen generation in the vicinity of the reactor cavity during the direct containment heating scenario.** Ginsberg, T.; Tutu, N.K. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 477-478(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The direct containment heating (DCH) scenario involves high-pressure ejection of molten core material from the reactor vessel into the region beneath the vessel and into various subcompartments of the containment building. The melt consists of oxides and unreacted zirconium and iron. The stored energy in the melt consists of the sensible energy and latent heat of the melt consists of the sensible energy and latent heat of the melt plus the chemical reaction energy of the various components that can react with either the steam or the oxygen within containment. The metals may first react with steam, if local conditions permit, and thereby produce hydrogen. The hydrogen may then burn at some later time at a different location in containment if conditions are appropriate for reaction. To predict the containment response, one must follow the motion of the melt through the various subcompartments of containment while computing the integrated release of energy from the melt to the containment atmosphere, the quantity of hydrogen produced during the time period that the melt is suspended, and the energy transfer to water in containment. Methods are being developed to integrate the various exchange processes into prediction of the pressure and temperature response of the containment building. This paper presents a discussion of several aspects of DCH phenomenology, relevant largely to pressurized water reactors (PWRs), based on the results of recent experiments and analyses.

51332 **DHCVIM - a direct heating containment vessel interactions module: applications to Sandia National Laboratories Surtsey experiments.** Ginsberg, T.; Tutu, N.K. (Brookhaven National Lab., Upton, NY (USA)). *Transactions of the American Nuclear Society;* **55**: 478-479(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Direct containment heating is the mechanism of severe nuclear reactor accident containment loading that results from transfer of thermal and chemical energy from high-temperature, finely divided, molten core material to the containment atmosphere. The direct heating containment vessel interactions module (DHCVIM) has been developed at Brookhaven National Laboratory to model the mechanisms of containment loading resulting from the direct heating accident sequence. The calculational procedure is being used at present to model the Sandia National Laboratories one-tenth-scale Surtsey direct containment heating experiments. The objective of the code is to provide a test bed for detailed modeling of various aspects of the thermal, chemical, and hydrodynamic interactions that are expected to occur in three regions of a containment building: reactor cavity, intermediate subcompartments, and containment dome. Major emphasis is placed on the description of reactor cavity dynamics. This paper summarizes the modeling principles that are incorporated in DHCVIM and presents a prediction of the Surtsey Test DCH-2 that was made prior to execution of the experiment.

51333 **Procurement and use of commercial grade items in safety-related nuclear applications.** Craig, W.E.; Mulford, T.J.; Tulay, M.P. *Transactions of the American Nuclear Society;* **55**: 480(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Nuclear Construction Issues Group under the sponsorship of the Electric Power Research Institute set into motion in December 1986 a funded task group of utility engineering, quality, and procurement experts to develop a guideline for procuring and using commercial grade items in nuclear safety-related applications. Commercial grade items (CGIs) are typically used in safety-related applications in nuclear power plants. The safety function of the CGI in safety-related assemblies may range from extremely minor to

critical. In general, the cost of the item is not related to its importance to the safety function of the assembly. Since all aspects of the procurement and use of CGIs in safety-related applications are not completely and clearly defined by existing regulations and standards, the results of the development of a guideline that contains the recommended elements to accomplish the procurement and acceptance process is the subject of this paper.

51334 **Commercial item verification - engineers require new knowledge base and skills.** Holzman, P.M. *Transactions of the American Nuclear Society;* **55**: 481-482(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In a recent project for EPRI, the author compared motor manufacturer practices for safety-related and commercial grade motors. The results indicate that, in the critical areas of design, material procurement, and manufacturing, vendor practices are essentially identical with differences only in documentation. Studies should be conducted to develop such information for other components. With this information at hand, utility engineers can more efficiently focus their attention on the additional measures necessary to complete an item's verification.

51335 **EPRI/NUS equipment qualification data bank spare parts applications.** Holt, D.C.; Sliter, G.E.; Steinberg, R.J.; Horn, R.H. *Transactions of the American Nuclear Society;* **55**: 482-483(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The Equipment Qualification Data Bank (EQDB) is a computerized, interactive, time-share data base containing summary equipment and materials information useful for environmental and seismic qualification. Access to the EQDB is available on a subscriber basis. The system is an efficient way for a user to survey: (1) whether specific equipment has already been qualified by another organization; (2) if other utilities have the same or similar equipment; (3) which manufacturers have particular equipment; and (4) the whereabouts of equipment qualification documentation, including radiation and thermal properties of materials.

51336 **Spare parts: issues and answers.** Aaron, D.S. *Transactions of the American Nuclear Society;* **55**: 483-484(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Since the Three Mile Island accident, due to many factors including the political and regulatory climate in the US, there have been a number of transitions in the functions necessary to build and operate a nuclear power plant. One of the functions that has changed significantly is the purchase and handling of spare parts. Using the example of the commercial grade solenoid valve, alternative methods of dedication may include source surveillance, partial reliance on supplier surveys and inspection, third party testing, or a combination of two or more methods. The focus is always the minimum requirements necessary to verify that the commercial grade item is adequate for use in a safety-related application.

51337 **Procurement and control of spare and replacement parts - a regulatory perspective.** Baker, E.T.; Grimes, B.K.; Merschoff, E.W. *Transactions of the American Nuclear Society;* **55**: 484-485(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

As the nuclear industry shifts from a construction to an operations orientation, a number of fundamental changes have occurred in the type of safety-related procurements and the manner in which the utilities accomplish these procurements. Specifically, procurements have shifted from the purchase of large systems and components by architect-engineers, and nuclear steam supply system (NSSS) suppliers to the procurement by utilities of subassemblies, individual pieces of equipment (e.g., breakers, relays), and small parts for repairing individual pieces of equipment. To ensure that equipment will continue to perform its intended function and to satisfy regulatory requirements utilities must consider several things: (1) does the equipment perform a safety function; (2) does the replacement part affect the safety function; and (3) does the replacement part affect the seismic or environmental qualification. If the answer to any of these questions is yes, the purchaser has two alternatives. He may procure the item as safety-related and require the supplier or manufacturer to comply with all the applicable technical and quality requirements or he may purchase the item commercial grade and perform the necessary inspections and tests to ensure the item meets the requirements, i.e., dedicate the item.

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 51437, 51608

2505 Flywheels

REFER ALSO TO CITATION(S) 51062

2506 Thermal

REFER ALSO TO CITATION(S) 50995

51338 **(BFR-R—66-1987) Glazed atrium and groundwater as heat sources for terrace houses in Landskrona.** Broberg, P.; Thulin, A. (Stiftelsen foer Industriellt och Ekologiskt Byggeri, Landskrona (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 88p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754386/JAW.

The objective of this project has been to describe the technical features of an experimental building project consisting of two detached houses and seven terrace house units linked to a glazed atrium. Heating is provided by an energy system in which 80 m deep wells serve as heat sources for heat pumps. Heat is also recovered from ventilation exhaust air from the houses, while fresh incoming ventilation air enters via the glazed atrium, which can make a certain energy contribution. The report describes the heating system, with particular emphasis on the design and performance of the glazed roof and its controllable insulating blinds. These have been designed in accordance with greenhouse practice, which differs considerably from ordinary building practice. Calculated specific energy consumption amounts to 36 kWh/m,year. The design objective was to get below 60 kWh/m,year, which should be compared with normal consumption for an apartment building of about 200-250 kWh/m,year. (authors).

51339 **(BFR-R—70-1987) Heat storage in a groundwater reservoir through induced infiltration of surface water. A case study in Hoegsby.** Olsson, P. (VIAK AB, Vaenersborg (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754388/JAW.

The objective of this project has been to investigate the feasibility of utilising the Hoegsby ridge and the Emaa river to produce a heat storage system in a groundwater reservoir. The principle involves storage during the summer of warm surface water in the ice-age deposits in hydraulic contact with the Emaa river. By abstracting large quantities of water from the aquifer during the summer, infiltration of river water is induced, raising the temperature of the aquifer by a few degrees. The thermal energy so supplied is then used during the winter as a heat source for heat pumps. The project has investigated both practical and theoretical prerequisities. The results show that the prospects for storage are probably good. The cost of the proposed system has been estimated at about SEK 3.5 million, and should provide an annual cost saving of about SEK 300 000 relative to the cost of solid fuel firing.

51340 **(HAA—8212) Aquifer thermal energy storage demonstration project. Phase 2. Engineering analysis and design. Final report.** (Hooper and Angus Associates Ltd., Toronto, Ontario (Canada)). 1 Dec 1982. 151p. (CE—01355). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report provides analysis and assessment of performance of an aquifer thermal energy storage (ATES) demonstration project at an Ontario office building. The project is to demonstrate the feasibility of cooling a large building in summer with cold stored from the previous winter in a natural aquifer. A comprehensive field program was carried out to define the aquifer's thermal and hydraulic characteristics. These parameters were required as input for a modelling program used to predict the aquifer's seasonal thermal storage capabilities. Field tests included pumping and sampling of test wells, constructing a withdrawal/injection well arrangement, piping the ground water through a portable boiler before injection to test the water flow, and analyzing the test results using a computer model. The building cooling load was investigated in detail to provide an accurate representation of both the seasonal and daily cooling requirements. The method of chilling the water during winter was examined and the optimum method of chilling the water using outside air was determined. The entire ATES system was analyzed and optimized to provide the most efficient storage system under the given conditions. This system incorporates 3 sets of well pairs spaced over an area so as to maximize the storage capacity. The winter chilling involves variable air and water flow cooling tower which provides the greatest amount of cooling for a given fan size. The summer waste water is to be reinjected at constant temperature in order to maximize the amount of cold recovered. 2 refs., 123 figs., 20 tabs.

51341 **(WU/ME—8208) A feasibility study of seasonal storage of coolness in Canada. Final report.** Bahadori, M.N.; Hollands, K.G.T.; Galpin, P.F. (Waterloo Univ., Ontario (Canada). Dept. of Mechanical Engineering). Aug 1982. 95p. (CE—01878). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Seasonal storage of coolness in the form of ice in both covered and uncoverd ice ponds, in the form of frozen soil, in ground in a rock bed and in aquifers are studied. A storage capacity of 10 TJ for the aquifer and 1 TJ for all others are considered. Six Canadian cities with different climatalogical conditions are considered for both technical and economic feasibility study of each of the systems. Technically, all systems are feasible anywhere in Canada. However, in cities which do not have sufficient number of hours of subzero temperatures, systems involving ice production and soil freezing are not possible and other systems have to be employed. The economic analysis of the coolness storage systems include the initial costs for the capacities mentioned and the cost per unit of coolness. The initial and unit costs of coolness are compared with a conventional vapor compression refrigeration system. The analysis shows that the cost of land, with the exception of aquifer storage system, plays an important role in determining both the initial and annual costs. When the land over the coolness storage system can be used for parking, landspacing, etc., or when the cost of land relevant to the storage system is negligible, ice making, soil freezing and aquifer storage systems are quite competitive with the conventional compression refrigeration units, whereas, with high land costs, only aquifer systems may be able to compete with these units. 102 refs., 79 figs., 17 tabs.

2509 Batteries

REFER ALSO TO CITATION(S) 50955, 51062, 51570, 51570

51342 **(CRIE-T—86054) Assessment of polymer and Lithium non-aqueous batteries for electric utility applications.** Tanaka, Toshichika; Matsuda, Yoshiharu; Osaka, Tetsuya. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 46p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770180/JAW.

New batteries like polymer or lithium secondary batteries have such characteristics that they operate at ordinary temperature, require no auxiliaries, and are light and powerful. CRIEPI and EPRI had an assessment meeting in November 1986 to evaluate the possibility of future applications of these new batteries to electric utility businesses. In the meeting, the present technology level, technical problems to be solved, future view and others were discussed. Especially, six batteries, -- Li/PPy, Li/PAn, Li/TiS2, Li/MoS2, Li/SPE/V6O13, Li/SO2/C -- were confirmed to be promising for saving electric power and the efficiency, the price, and others were evaluated. Some of the results are as follows. 1. New batteries are promising for electric utility businesses. 2. Technological development is necessary to prolong cycle life and reduce cost. 3. Safety must be considered. (16 figs, 14 tabs, 17 refs)

51343 **(CRIE-T—86055) Development of secondary batteries for load conditioner battery system. Target specifications and candidate materials.** Ishihara, Kaoru; Terada, Nobuyuki; Takei, Katsuhito; Kumai, Kazuma; Nitta, Yoshitaka. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). May 1987. 40p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770175/JAW.

Establishment of target specifications for new lithium cells considering the performance and characteristics required for load conditioner (LC), selection of battery systems utilizing the materials which would satisfy the requirements, rough designing, and extraction of development problems are described. The target specifications for the cells were studied on the assumption that the residential use LC should be less than 360 kg and 300 liters. As the result of the study, the following became clear: The total capacity is more than 16 kW. Specific energy is more than 70 Wh/kg and 120 Wh/liter. Energy efficiency in a charge/discharge cycle is more than 80 percent to achieve 70 percent AC-AC efficiency. Intercalation compounds such as vanadium oxides and chlomium oxides, and conducting polymers such as polyacenic compound and polyaniline are excellent candidate materials for positive electrodes. (13 figs, 10 tabs, 20 refs)

51344 **(CRIE-T—86056) Research and development of zinc-iodine cell (Part 1). Characteristics of 0.2Wh cell.** Iwahori, Toru; Ishikawa, Rikio; Maruyama, Kensaku; Sugawa, Hiroshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1987. 47p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752073/JAW.

To study the applicability of zinc-iodine cell to such electric enterprise uses as load conditioner and the like, we have fabricated and tested 0.2 Wh cell. The weight and volume energy densities of the cell are 18 - 26 Wh/kg and 60 - 100 Wh/l, respectively, which is considerably smaller than the theoretical values. It is necessary to improve them by modifying the specifications of materials or the like. In eight hour charge eight hour discharge test at a constant current 0.13c (19.5 mA), the voltage variation range is +-35%, which is a large value and reduction measures thereof is required DC energy efficiency was not less than 80% up to discharge current 0.1 - 0.3c. Its cycle life, suppression measures against the growth of dendrites on the zinc electrodes are needed. Hereafter the development of 1 - 10 Wh class cell by the adoption of the enlargement of electrode area and lamination of single cell is scheduled. (26 figs, 13 tabs, 25 refs)

51345 **(DOE/ER/13675—1) [Solid state voltammetry and sensors in gases and other non-ionic media]: Performance report, April 1, 1987--March 31, 1988.** Murray, R.W. (North Carolina Univ., Chapel Hill (USA). William R. Kenan, Jr. Labs. of Chemistry). 1988. Contract FG05-87ER13675. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014738/JAW.

Progress is briefly described in the design and performance of an electrochemical microcell. This microcell contacts wire tips of 10μm Pt working microelectrode and Ag reference and Pt auxiliary electrodes, sealed in glass and plastic, with a few micrometer thick film of an ionically conducting polymer {open←quotes}solvent{close←quotes} containing dissolved electroactive monomers. The other side of the polymer film is contacted by a selected bathing gas from which other reagents can sorb into the polymer as reactants or as plasticizers. Using lithium triflate/poly(ethylene oxide), PEO $LiCF_3SO_3$, as the ionically conducting polymer solvent and species like ferrocene as electroactive solute, we demonstrated that quantitatively interpretable cyclic voltammetry could be carried out. We have recently completed work on a second and more elegant microcell design that defines the three electrodes of the cell microlithographically, with the working

electrode being either a 11 {times} 516 or 11 {times} 256μm microband or an 11 {times} 11μm square. Other work concerns electrochemical reactivity in PEO $LiCF_3SO_3$ and other polymer solvents. 5 refs.

51346 **(PB—88-226758/XAB) Lithium batteries for electronic devices.** Sudo, H.; Hirata, I. (Mitsubishi Electric Corp., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01. Included in Mitsubishi Denki Giho, Vol. 62, No. 3, 71-76(1988).

Many advanced electronic products require small, lightweight batteries with a high energy density and minimal voltage drop over the rated battery life. Toyotakasago Dry Battery and Mitsubishi Electric developed new high-energy lithium thionyl chloride batteries designed to operate at temperatures from -55 to approx. 85°C. The capacity drop is within 1% per year during storage, and the voltage drop within 1% during use. The energy density is 480 mWh/g. This is about ten times the energy density of managanese dioxide batteries, and the highest commercially available.

51347 **(SAND—88-0435) Evaluation of terrestrial nickel/hydrogen cells and batteries.** Bush, D.M. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014702/JAW.

A nickel/hydrogen battery is being developed for terrestrial applications such as remote solar. The main thrust continues to be the reduction of cost compared with aerospace technology. The latest battery design consists of individual prismatic cells in a sealed common pressure vessel. The development work has been conducted at COMSAT Laboratories and, more recently, at Johnson Controls, Inc., under cost-sharing contracts. Contract deliverables include cells and batteries for evaluation, with six cells and two batteries currently on test at Sandia. Continuous-cycle testing is conducted, as well as tests to characterize the system. Also, solar tests have been conducted with a battery connected directly to a photovoltaic array. The results of these tests are discussed. 10 refs., 17 figs., 4 tabs.

51348 **Method for improving voltage regulation of batteries, particularly Li/FeS/sub 2/ thermal batteries.** Godshall, N.A. (to Dept. of Energy, Washington, DC). US Patent 4,761,487. 2 Aug 1988. Filed date 10 Jun 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a battery composition useful as the cathode of a Li/-FeS/sub 2/ thermal battery, consisting essentially of substantially pure FeS/sub 2/, the improvement is described wherein sufficient lithium is added to the composition whereby the resultant composition falls into a three-phase thermodynamically invariant region of the Li/Fe/S phase diagram and has the formula Li/sub x/FeS/sub 2/ with the proviso that $0.05 \leqq x \leqq 1.5$.

51349 **Amorphous cathode material for use in lithium electrochemical cell and lithium electrochemical cell including the amorphous cathode material.** Uchiyama, M.C.; Slane, S.M. (to Secretary of the Army, Washington, DC). US Patent 4,751,158. 14 Jun 1988. Filed date 3 Aug 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A cathode for use in a lithium electrochemical cell is described comprising a cathode mix of amorphous materials prepared from the mixed-metal oxide (V/sub 0.7/Mo/sub 0.3/)/sub 2/O/sub 5/ and P/sub 2/O/sub 5/ combined with a mixture of conductive diluent and binder and pressed into electrodes on a nickel screen and sintered under vacuum at about 280°C.

51350 **Cathode material for use in lithium electrochemical cell and lithium electrochemical cell including the cathode material.** Uchiyama, M.C.; Slane, S.M.; Salomon, M. (to Secretary of the Army, Washington, DC). US Patent 4,751,157. 14 Jun 1988. Filed date 8 Jun 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A cathode for use in a lithium electrochemical cell is described comprising a mix of about 40 to 99 weight percent of a mixed metal oxide prepared from V/sub 2/O/sub 5/ and MoO/sub 3/, wherein the mixed metal oxide prepared from V/sub 2/O/sub 5/ and MoO/sub 3/ is selected from the group consisting of V/sub 9/Mo/sub 6/O/sub 40/, a solid solution of V/sub 9/Mo/sub 6/O/sub 40/ with V/sub 2/O/sub 5/, and a solid solution of V/sub 9/Mo/sub 6/O/sub 40/ with MoO/sub 3/, about 0 to 30 weight percent of a conductive diluent and about 1 to 30 weight percent of an aqueous based binder, wherein the mix is rolled onto a nickel screen and sintered under vacuum at about 280°C.

29 ENERGY PLANNING AND POLICY

51351 **(CRIE—686005) Stabilization of free-burning arcs between new type jumper horns for 500 kV transmission lines.** Shibuya, Masatoyo; Amakawa, Masashi; Onishi, Masaru. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1986. 28p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770156/JAW.

Arc-holding performance of two types of new jumper horn for 500 kV transmission wire tension-proof equipment was experimentally clarified using an actual-scale tension-proof unit together with the influence of wind on the arc retention. 1. Arc-holding performance at windless air: Both two horns (A and C) showed better performance than the conventional ones with holding time of approximately 300 ms. 2. Arc-holding performance at strong wind (10 m/s): Both horns on the arm side hold the arc on the born for 80 ms. On the jumper side, arc of the type A horn are stable in 100 ms. However, arcs of the type C horn often becomes unstable in less than the fault duration (70 ms) of power transmission systems. (19 figs, 3 tabs, 8 refs)

51352 **(CRIE—686007) Insulation recovery characteristics after arc interruption of UHV AC transmission lines. In case of suspension insulator assemblies.** Goda, Yutaka. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Sep 1986. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770157/JAW.

An experimental unit for arc current extinction test which is resistant to a super-voltage of UHF system was developed. An insulation recovery characteristics after the current extinction was measured and examined by generating arc between the horns of real-scale, 2-line suspension insulator assembly, centering the measurement around the most severe 4 kA. The results are as follows: 1. Regardless of the primary arc current values, at 0.6 sec after primary arc current interruption, there is no flash over along the suspension insulator assembly under the suppression of 1440 kV as a switching impulse voltage. 2. In the case of following conditions, about 0.7 sec is necessary for dead time of rapid auto-reclosing after primary arc interruption. i) A lightening flashover occurs between the horns of suspension insulator assemblies. ii) Insulation recovery voltage decreases by about 10 % due to the influence of tower arm width, etc. (17 figs, 2 tabs, 9 refs)

51353 (IZ—8601, pp 48-52) **Research and development of pyroelectric energy converters using ferroelectric materials.** Kawabata, Akira; Shiozaki, Tadashi; Adachi, Masatoshi; Shimizu, Masaru. (Kyoto Univ., Faculty of Engineering, Kyoto, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

In order to realize a converter of high performance, $LiTa(1-x)Nb(x)O_3$ ceramic and $PbZr(1-x)Ti(x)O_3$: $x=0.1$, 0.15 ceramic were produced and their fundamental characteristics were measured. Concerning the former ceramic, optimum calcination temperature is 1000 - 1100 °C, burning temperature is 1400 °C, Curie temperature is 658 - 800 °C at $x = 0$ - 0.3. Although it increases linearly, the improvement of the production method is necessary, as the surface particle size is very large and voids are frequently observed. Concerning the latter ceramic, it was burned at 1200 °C, and Curie temperature was low as 260, 280 °C at $x = 0.1$ and 0.15. But its pyroelectric characteristics is excellent and is promising as a material for solid heat engine. (7 figs, 7 refs)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 51420

51354 **(DOE/CE—0202-2) FEMP Update: Federal energy management activities.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Federal Energy Management Program). Spr 1988. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013757/JAW.

The FEMP Update, published quarterly by the Federal Energy Management Program (FEMP), provides information to Federal managers that will assist them in their energy management responsibilities. The Update is distributed primarily to Federal facility and energy management personnel. The Federal Energy Management Program is responsible for the overall coordination of the Government's energy management efforts. This update covers: photovoltaics; shared energy savings; privately finaanced energy projects; Federal Energy Management Act; US Army energy waste reduction awards program; and other energy management related topics.

51355 **(EMR—8103) Canadian energy system supply and demand sensitivity studies. Vol. 1. Methodology, results and discussion.** Teichmann, T. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Mar 1981. 136p. (CE—01887). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An analytical study of a model representing the Canadian energy supply and demand system over the period 1977-2022 is presented. The systems analysis method is based on the MARKAL computer model. The computations select a set of energy technologies to meet projected demands and satisfy the objectives of minimum oil imports and minimum total discounted cost over the period considered. The optimal sets of such supply and utilization technologies are given as a function of time and recorded at 5-year intervals. The results also depend on the inputs which are restricted to technical parameters. Limits on available labor and capital are included as bounds on plant capacities and/or growth rates. The reference case represents the situation most likely to apply in actuality. Major (hypothetical) restraints on primary supplies are examined to test the energy system sensitivity and resilience. The main characteristics of the Canadian energy system which emerge from these studies include the following. All the major new supply technologies (e.g. syncrude, coal gasification) play an important role in meeting Canadian energy needs over the period considered. New utilization technologies involving conservation and the use of biomass lead to a substantial reduction in final energy requirements. Syncrude production is crucial for energy self-sufficiency. Hydro power provides a steadily increasing fraction of energy demand; gas plays an essential and relatively inflexible role as a fuel; major new uses for coal are called for in the later decades. A response time of 10 or more years is needed for the energy system to accomodate major pertubations in a primary supply technology. 70 refs., 48 figs., 6 tabs.

51356 **(MU/HEC—8512) Structure and feasibility of a regionalised MARKAL-Canada model.** Baillard-Haurie, D. (Montreal Univ., Quebec (Canada). Ecole des Hautes Etudes Commerciales). Dec 1985. 52p. (In French). (CE—01883). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This paper consists in a preliminary study for the assessment of the advantages and feasibility of a regionalized energy model for Canada, based on the MARKAL modelling approach. It first looks at the current energy exchanges between the Canadian regions; the considerable regional differences in primary sources and in energy consumption are shown through a series of statistics. A global energy model which would explicitly take into account the energy exchange activities is then proposed; the variables and the constraints to include in this model are specified. The optimization techniques necessary for the treatment of such a large model are also considered. The report concludes with a positive evaluation of the feasibility of the proposed modelling. 33 refs., 2 figs., 15 tabs.

51357 **BUILD-1. A disaggregate model of the U.S. electric utility industry.** Hillsman, E.L.; Alvic, D.R.; Church, R.L. (Oak Ridge National Lab., Oak Ridge, TN (USA)). *European Journal of Operational Research;* **35**: No. 1, 30-44(Apr 1988).

A linear programming model is presented of the U.S. electric utility industry which explicitly represents each of the nation's 300 electric utilities and the options each has for meeting demand for electric energy. The model has been designed to estimate how the utility industry would respond to changes in policy or energy markets, especially in the present period of slow growth in demand and limited opportunities for expansion. By estimating the use, upgrading, retrofitting, and retirement of individual generating facilities with known geographical coordinates, the model provides the geographically detailed results needed by models of pollutant transport and other regional environmental impacts. 23 refs., 2 tabs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 50898, 50929, 50930, 51076, 51104, 51354, 51374, 51424, 51430, 51432, 52895

51358 **(ESC—43) A world of differences, the normative EOS-scenarios. Final report of a study to found the normative scenarios of the project Energy research scenarios of the Energy Study Centre (ECN, Petten, Netherlands).** Dinkelman, G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum; Rijksuniversiteit Leiden (Netherlands)). Nov 1987. 85p. (In Dutch). NTIS (US Sales Only), PC A05/MF A01 - Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands. Order Number DE88754259/JAW.

Three competing political and economical 'concepts of control' which underlie three normative energy-scenarios are described. The aim of the literature-research carried out for this report was to make the original scenarios more recognizable, and to find out which groups could be expected to support them. The concepts of control bear the names 'Dynamic and growth', 'Dirigation and blockbuilding' and 'Shared development'. They can be seen, so is argued, as competing perspectives on a so-called 'post-Fordist' world. The three concepts of control differ on what they see as common interests and the way they should be looked after. Topics in the description are: the desired rate of European political and economical integration, the borders of Europe, Europe's position in the world, the acceptance of new technologies, the goals they should be used for, and perceived relationships between energy, environment and economy. The scenarios show what happens if these three concepts of control become hegemonic without being forced to compromises. For all three scenarios a short sketch is given of the corresponding dominating energy- and environmental policy and of future relationships within OECD and between OECD on the one hand and NIC's/LDC's on the other. The conclusion of the report is that the ideological differences between the neoliberalism of 'Dynamic and growth' and the green, direct-democracy-politics of 'Shared development' are not as big as they were in the seventies. Especially on the new policy-areas like technology, energy and environment they get closer. But this does not mean that the concept of 'Dirigation and blockbuilding' can be put completely aside. Its goal of economic equality and its emphasis on government dirigation may become more attractive again if it comes out that market regulation leads to a dual society and that it was state-intervention (by environmental legislation) that created the market for environmental technologies. 43 refs.

51359 **(ESC-WR—88-18) Relationship between GDP, energy use and total costs of energy.** Boonekamp, P.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jul 1988. 14p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the International energy workshop, Honolulu, Hawaii, 14-15 June 1988.

In 1987 a National Energy Outlook (NEV) was completed for the Netherlands which resulted in a set of three energy scenarios for the period 1985-2010. In these scenarios the ratio between the growth rate of GDP (Gross Domestic Product) and the growth

rate of energy use varies between 0.35-0.50. The total costs of energy per unit of GDP decrease to 3/4 of their 1985 level despite energy prices which are up to 60% higher. To explain these figures an analysis is presented of the major factors determining energy use and costs. Next will be shown how the factors influenced different parts of the energy system and lastly their relative importance in keeping down the level of total energy use and costs of energy.

51360 **(ESC-WR—88-19) Import and export of energy in the Netherlands, 1960-1987. Analysis of quantity, value and price.** Koenders, N.J.; Kossen, A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Aug 1988. 57p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Trend analysis concerning energy prices from the past is useful in setting up price prognosis and gives insight in the correlation between the prices of different energy sources. This report gives insight in quantity, value and price of energy import and export in the period 1960-1987 on the basis of CBS statistics (Dutch Central Bureau for Statistics) and figures resulting from these statistics. Successively crude oil and oil products, coal, natural gas, electric power and uranium come up for discussion. Distinction is made for each of those energy sources between import and export. Except for crude oil and oil products the import is subdivided into countries of origin and the export is subdivided into country of destination. Finally import prices are compared. 21 figs., 21 tabs.

51361 **(LA—11279-MS) The nuclear future: Political and social considerations.** Tucker, R.W. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 10p. (CNSS/Papers—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015474/JAW.

This essay speculates about the nuclear future on the basis of the record of past prophecies about the effects of nuclear weapons, the broad relationship between technological development and international politics, the effects of further proliferation of nuclear weapons, and the implications of broad societal trends in the west tending toward the delegitimation of nuclear deterrence.

51362 **(MEM—1987) Manitoba Energy and Mines annual report, 1986-87.** (Manitoba Ministry of Energy and Mines, Winnipeg (Canada)). [1987]. 59p. (MICROLOG—88-03634). Manitoba Dept. of Energy and Mines, Legislative Bldg., Rm. 301, Winnipeg, Man., Canada R3C 0V8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The medium- and long-term direction of the Department of Energy and Mines, in addressing its mandate, is to ensure continuity and enhancement of future benefits from Manitoba's mineral and energy resources. During the year, these functions were carried out by four main divisions, Energy Management, Minerals, Petroleum, and Policy, Planning and Project Development, with support from the Financial and Administrative Services Division, and the Communications and Community Relations Division. Additionally it has responsibility for the Oil and Natural Gas Conservation Board, and the Manitoba Energy Council. A summary of expenditures of the Department for the year is given. Also, the activities of the divisions and associated boards and councils are described. These include energy conservation programs for the home and industry, renewable energy demonstration projects, geological exploration and research, mining and petroleum industry activities and programs, and energy and resource policy, planning and project development.

51363 **(NSAEC—8712) Cost of fuel and utilities Newfoundland and Labrador, 1987.** (Newfoundland Statistics Agency Executive Council (Canada)). Dec 1987. 76p. (MICROLOG—88-02744). Newfoundland Statistics Agency, Executive Council, Confederation Bldg., St John's, Nfld., Canada A1C 5T7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This survey of fuel and utility consumer prices examines retail prices in a number of Newfoundland communities for furnace oil and stove oil, regular and unleaded gasoline, diesel fuel oil and electricity. The survey also compares the difference in petroleum product prices and electricity rates throughout the Province between the current year and the past year. The historical supplement shows how prices have moved since the survey started in 1975. Also included are price comparisons of some fuels in the major cities of Canada.

51364 **(PB—88-216924/XAB) Simple forecasting model linking macroeconomic policy to industrial employment demand. Staff report.** Malley, J.R.; Hady, T.F. (Economic Research Service, Washington, DC (USA). Agriculture and Rural Economy Div.). Apr 1988. 41p. (AGES—880204). NTIS, PC A03/MF A01.

See also PB—86-113511.

Simulation through a model linking monetary and fiscal policy to industrial employment in metro and nonmetro areas of four U.S. regions suggests that changes in monetary and fiscal policy have significantly different effects in different parts of the country. The magnitude of the employment impact on nonmetro areas depends on assumptions about industrial composition and worker compensation.

51365 **(RISO-M—2676) Energy planning and project procedures in Zambia.** Christensen, J.M. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754412/JAW.

The energy situation in Zambia is described in detail following a general introduction to the Zambian society. The contribution of the different commercial and woodfuel energy sources to the energy supply in the different sectors is analysed and policy options outlined. The political and administrative structures especially within the energy sector are presented, and the existing formal and informal project handling procedures are analysed. The present situation is generally characterized by limited Zambian influence on project analysis and selection, while foreign donor interests are found to have great impact through very early involvement in the identification and preparation phases. 12 tabs., 7 ill., 28 refs.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 50636, 50737, 51104, 51212, 51214, 51215, 51255, 51403, 51422, 52072, 52074, 52075, 52076, 52117, 52118, 52150, 52151, 52152, 52165, 52184, 52185, 52186, 52187, 52188, 52189, 52190, 52191, 52192

51366 **(PB—88-232780/XAB) Characterization of municipal solid waste in the United States, 1960 to 2000 (update 1988).** Franklin, M.A. (Franklin Associates, Prarie Village, KS (USA)). Mar 1988. 43p. NTIS, PC A03/MF A01.

See also PB—87-178323; Portions of this document are not fully legible.

Knowledge of the quantities and composition of municipal solid waste (MSW) is a necessary tool for many aspects of solid-waste management. This report, which is an update of previous work in 1986, presents a summary of estimates of historical MSW quantities and composition from 1960 to 1986, with projections to the year 2000. The material-flows methodology developed by EPA in the early 1970s, with refinements that have been added in succeeding years, was used to make these estimates.

51367 **(PNL-SA—15658) Estimating cumulative environmental impacts of proposed projects.** Murthy, K.S. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 8p. (CONF-880601—45). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014759/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Environmental documents typically include descriptions of direct impacts, indirect impacts, and cumulative impacts. Methods used for estimating direct impacts, such as an increase in the sulfur dioxide concentration in the air, are usually well understood and have received adequate attention in environmental documents. Indirect impacts, such as secondary developmental activities related to a new highway project, are difficult to define or predict, and tend to be ignored because of their nebulous nature and apparent irrele-

vance. Cumulative impacts, which are the subject of this paper, are important and should receive more careful and detailed attention than has been the case in most environmental impact documents. Attempts to define cumulative impacts have been made. The purpose of this paper is to focus on the importance of cumulative impacts for the benefit of the preparers of environmental documents and decision makers. 2 refs., 2 figs.

51368 **(SNV—3155) Environmental problems from Society point of view. Social science and environmental protection research.** Lundgren, L.J. (National Swedish Environmental Protection Board, Solna). May 1986. 70p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754427/JAW.

The report analyses the question of the sociological contribution to environment research. (G.B.).

51369 **(SNV—3162) Exhaust gases from automobiles. What can communities and individual people do?.** Grauers, S. (Grauers Konsultbyraa, Moelndal (SE)). (National Swedish Environmental Protection Board, Solna). Jun 1986. 96p. (In Swedish). NTIS (US Sales Only), PC A05. Order Number DE88754429/JAW.

The main source of air pollution in population centres is motor traffic. This is true for most substances. The measured carbon monoxide and lead contents practically entirely originate from traffic, and also c:a 90% of the nitrogen oxides in highly frequented streets. The Swedish automobile exhaust gas situation has been elucidated by calculations and measurements. These show a strong dependence of the exhaust gas problem from locality size. In small places the exhaust gas problems mainly exist in high traffic through routes. In densely built-up areas the streets in the centre and the big access roads are often exposed to high pollution levels. In Stockholm, Gothenburg and Malmoe the problems are present far outside the centre areas and the main streets suffer from high pollution levels. The governmental motor car exhaust gas committee estimates that in population centres of more than 10 000 inhabitants there are more than 1250 kilometres of streets where the figures for carbon monoxide or nitrogen dioxide or both exceed the limits recommended by WHO. Along these streets c:a 100 000 people are living and c:a 100 000 are working. The main part of these are to be found in the three cities. (O.S.).

51370 **(UCRL—21045) Natural Phenomena Hazards Modeling Project: Preliminary flood hazards estimates for screening Department of Energy sites, Albuquerque Operations Office.** McCann, M.W. Jr.; Boissonnade, A.C. (USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety; Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 425p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE88014937/JAW.

As part of an ongoing program, Lawrence Livermore National Laboratory (LLNL) is directing the Natural Phenomena Hazards Modeling Project (NPHMP) on behalf of the Department of Energy (DOE). A major part of this effort is the development of probabilistic definitions of natural phenomena hazards; seismic, wind, and flood. In this report the first phase of the evaluation of flood hazards at DOE sites is described. Unlike seismic and wind events, floods may not present a significant threat to the operations of all DOE sites. For example, at some sites physical circumstances may exist that effectively preclude the occurrence of flooding. As a result, consideration of flood hazards may not be required as part of the site design basis. In this case it is not necessary to perform a detailed flood hazard study at all DOE sites, such as those conducted for other natural phenomena hazards, seismic and wind. The scope of the preliminary flood hazard analysis is restricted to evaluating the flood hazards that may exist in proximity to a site. The analysis does involve an assessment of the potential encroachment of flooding on-site at individual facility locations. However, the preliminary flood hazard assessment does not consider localized flooding at a site due to precipitation (i.e., local run-off, storm sewer capacity, roof drainage). These issues are reserved for consideration by the DOE site manager. 11 refs., 84 figs., 61 tabs.

2904 Natural Resources

REFER ALSO TO CITATION(S) 50929, 50930, 50988, 51360, 51362, 51366, 51397

51371 **(AFLW—88) Technical publications Alberta Energy, Alberta Forestry, Land and Wildlife.** (Alberta Dept. of Forestry, Lands and Wildlife, Edmonton (Canada). Public Lands Div.). 1988. 40p. (MICROLOG—88-03640). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This catalogue includes technical publications in the fields of energy and energy conservation, mineral resources, fish, forests, climate, land and land use, land conservation and management, resource management, surveying/mapping, and wildlife, all related to Alberta.

51372 **(AFLW—8801) General publications, Alberta Energy/Alberta Forestry, Lands and Wildlife, 1988.** (Alberta Dept. of Forestry, Lands and Wildlife, Edmonton (Canada). Public Lands Div.). Jan 1988. 21p. (MICROLOG—88-03641). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This catalogue covers publications of general interest in the fields of energy conservation, nonrenewable energy resources, fish and wildlife, forests, land and land use, outdoor activities, and surveying/mapping, all relating to Alberta. Publications are coded according to reading level and readership interest.

51373 **(PB—88-207139/XAB) Utilization of the by-products produced by the pulping industry.** (National Timber Research Inst., Pretoria (South Africa)). 1988. 12p. (R/HOUT—314). NTIS, PC E04/MF E04.

Abstract in Afrikaans; North American Continent sales only.

The South African pulping industry produces large quantities of lignin and hemicellulose as unutilized by-products. The properties of the local alkali lignins were investigated and uses are currently developed for these lignins. The uses developed for the by-product hemicellulose are also discussed.

51374 **(PB—88-220801/XAB) United Kingdom mineral statistics, 1986.** Fellows, M.E.; Linley, K.; Joseph, P.; Slater, D. (British Geological Survey, Keyworth). 1988. 177p. NTIS, PC E09/MF E09.

See also report for 1985, PB—86-245669.

The edition presents minerals production, consumption, import and export data obtained from a wide variety of published and unpublished sources. All the contents have been systematically updated by one year and revisions for earlier years have been made wherever more up-to-date information has become available. Minor revisions have been made to the maps and diagrams. For the third year running the Commodity Summaries section includes estimates of apparent consumption for seven metals for which there are no reported statistics, namely, chromium, cobalt, manganese, molybdenum, titanium, vanadium and zirconium.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 50627, 50930, 50977, 50978, 51042, 51393, 51394, 51411, 51421, 51432, 51435, 51436, 51518, 51577, 51722, 52412

51375 (ANL/EES-TM—349) Determinants of effectiveness of international collaborative research and development: Project status report. Szpunar, C.B.; Dials, G.E.; Gillette, J.L.; Buehring, W.A. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016859/JAW.

At the request of the US Department of Energy, Office of the Assistant Secretary for Fossil Energy (DOE/FE), Argonne National Laboratory developed a method to help DOE/FE decision makers assess the desirability of participation in specific international collaborative research and development (R & D) activities. Based on a review of 71 completed, existing, and planned R & D agreements, followed by structured interviews and preference assessments with individuals experienced in international coal research activities, six attributes for measuring the effectiveness of such agreements were chosen: (10 probability of achieving agreement-specific objectives, (2) US balance-of-trade implications, (3) joint commitment of the R & D partners, (4) distribution of anticipated benefits from the R & D, (5) professional challenge and worthiness of the R & D, and (6) level of industrial participation. Based on decision-analysis principles, utility functions were then developed reflecting the preferences of the experts with regard to the attributes. These attributes and utility functions comprise the basic methodology tools. The methodology was then used to rank 22 completed agreements, as well as 23 proposed R & D topics, in order of their highest desirability for DOE/FE participation. The proposed topics were selected from a list of over 100, involving 21 developing countries, identified as having potential for DOE/FE collaboration. 3 refs.

51376 (ANL/TIS—87-2) Argonne National Laboratory 1986 publications. Kopta, J.A.; Springer, C.J. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88016752/JAW.

This report is a bibliography of scientific and technical 1986 publications of Argonne National Laboratory. Some are ANL contributions to outside organizations' reports published in 1986. This compilation, prepared by the Technical Information Services Technical Publications Section (TPS), lists all nonrestricted 1986 publications submitted to TPS by the Laboratory's Divisions. Author indexes list ANL authors only. If a first author is not an ANL employee, an asterisk in the bibliographic citation indicates the first ANL author. The report is divided into seven parts: Journal Articles -- Listed by first author; ANL Reports -- Listed by report number; ANL and non-ANL Unnumbered Reports -- Listed by report number; Non-ANL Numbered Reports -- Listed by report number; Books and Book Chapters -- Listed by first author; Conference Papers -- Listed by first author; and Complete Author Index.

51377 (BNL—41425) User facilities at federal laboratories. Baron, S.; Marcuse, W. (Brookhaven National Lab., Upton, NY (USA)). Apr 1988. Contract AC02-76CH00016. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015977/JAW.

Recent initiatives by the Congress and the Administration have been directed to improving American industrial competitiveness. One of these initiatives is directed to encouraging industrial users to avail themselves of special facilities existent at federal laboratories. The facilities available at the National Bureau of Standards (NBS) and seven Department of Energy (DOE) laboratories are presented here. One facility at each Laboratory is described in detail, the remainder are listed with the names and telephone numbers of individuals to contact for further information.

51378 (CONF-880920—1) The commercialization process and future energy options. Brown, M.A.; Snell, S.A. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01. Order Number DE88012939/JAW.

From International symposium on energy options for the year 2000; Wilmington, DE, USA (14 Sep 1988).

The commercialization of new energy technologies is a complex and difficult process. Few energy-related inventions are successfully translated into products and once on the market, many do not survive. Reasonable predictions about energy options in the year 2000 require a full understanding of the commercialization process as it pertains to new energy technologies. Drawing upon the experiences of the US Department of Energy's Energy-Related Inventions Program (ERIP), this paper outlines some of the patterns, processes, and problems related to the commercialization of new energy technologies. Energy price fluctuations, inadequate investment capital, insufficient market demand, and inappropriate commercialization strategies are found to be common problems besetting ERIP inventors. 12 refs., 4 figs.

51379 (DFVLR-ITP/IB—441/463-83) Non-nuclear energy research in the Federal Republic of Germany. Balance and outlook. Nitsch, J. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Stuttgart (Germany, F.R.). Inst. fuer Technische Physik). Jun 1983. 83p. (In German). Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V. (DFVLR), Stuttgart (Germany, F.R.). Inst. fuer Technische Physik.

After taking a look at the present situation of energy supply in the Federal Republic of Germany the book reports on the non-nuclear energy research of 1972-1982. The topic is divided into the following main points: 1) Criteria of supporting technologies; 2) A comprehensive look at the support programs and the classification of the individual areas; 3) The program 'non-nuclear energy systems'; 4) The partial program 'rational utilization of energy in the spheres of application and secondary energy'; 5) The partial program 'new energy sources'; and 6) The partial program 'coal and other fossil energy sources'.

51380 (INIS-mf—11765) Karlsruhe Nuclear Research Centre. Programme budget 1988. As of December 10, 1987. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1987. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754328/JAW.

Following a general survey of tasks, planned activities and developmental trends of the nuclear research centre, the report gives an account of the activities to be performed in the subject fields of main interest, showing the budgeting figures for annual expenditure (for personnel, investments, operating costs) up to the year 1991. Further information explains the infrastructure of the centre and the distribution of overall expenditure as well as the budgetary planning.

51381 (JITA—8701) Information survey on new energy technology development. (Japan Industrial Technology Association, Tokyo). Mar 1987. 230p. (In Japanese). Japan Industrial Technology Association, 2-7-4, Nishishinbashi, Minato-ku, Tokyo.

In developing new energy technology, it is necessary to make up a long term plan on the basis of deep considerations on both the trend of the energy demand and the needs of the social economy. This survey collected, on the macroscopic basis, the informations on the governmental policy on energy development, trend of move of government institutions and enterprises on the technical development, and documents as a result of conference and academic meetings. As an example, the USA section consists of descriptions on: DOE budget of the Federal Government. Solar energy (Solar cell, solar thermal). Geothermal energy. Coal energy. Ocean energy. Biomass energy. This report consists totally of 230 pages, the break down of which is 83 pages for USA section, 34 pages for West germany, 28 pages for UK, 32 pages for France, and 44 pages for a literature list in the countries outside Japan.

51382 **(LAO—308) Los Alamos Operations: Quarterly progress report, May-July 1988.** (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations). Sep 1988. Contract AC08-88NV10617. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016473/JAW.

The Los Alamos Operations (LAO) of EG and G/EM provides close proximity support to the Los Alamos National Laboratory. The work done at LAO includes direct support of the Los Alamos TO programs and the DOE-funded EG and G/EM R and D program, as well as miscellaneous special cash orders for projects using LAO's developed expertise and unique facilities. This progress report highlights LAO's many areas of technical involvement. Projects in progress, or done at LAO under other funding sources, i.e., R and D, cash orders, Economy Act Orders, etc., as well as miscellaneous programmatic tasks, are included in Sections V and VI. They are included for completeness and to illustrate the varied but complementary nature of the work done by LAO personnel.

51383 **(MLM—3528) Precision operations and product testing: Technology Update-86.** (Monsanto Research Corp., Miamisburg, OH (USA). Mound). Apr 1986. Contract AC04-76DP00053. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016547/JAW.

The five papers in this issue of Technology UPDATE provide diverse examples of precision operations at Mound. Inspection to close tolerances with our customized measuring system, centralized mass spectrometric analysis of process gases, evaluation of product with computer-generated solid models, and two forms of nondestructive testing - microfocus x-ray and high-speed spin testing - are the subjects of the papers in this issue. None of this work would be possible without the use of computers. But these examples by no means cover the entire range of our precision operations. Other applications include machining control, analytical techniques, process planning, product evaluation and testing, and destructive testing of components.

51384 **(PB—88-214127/XAB) Technology and the American economic transition: choices for the future.** (Office of Technology Assessment (U.S. Congress), Washington, DC). May 1988. 505p. (OTA-TET—283). NTIS, PC A22/MF A01.

Also available from the Supt. of Docs.; Library of Congress catalog card no. 87-619892.

This report examines basic U.S. policy choices made necessary by profound changes in America's technological base, changes in international trade, changes in resource costs, and changes in American tastes. The report does this by describing the performance of the U.S. economy as a set of complex networks linking manufacturing and service enterprises to deliver goods and services to American consumers, and by describing how choices made about the management of these networks could affect the quality of American life during the next two decades.

51385 **(STEV—1988-R1) IEA Bioenergy. Annual report 1987.** (Statens Energiverk, Stockholm (Sweden)). 1988. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754444/JAW.

Most of the work in the Executive Committee and in the Technical Advisory Committees has been concentrated on a follow-up of the work in the present Tasks and on the planning of new Tasks for the period from 1989. Efforts have also been made to get new countries interested to join the Agreement. Italy and Spain are presently considering doing so. The three ongoing tasks for 1986-1988 are: 1. Improvement of Biomass Growth and Production Technology in Short Rotation Forestry for Energy. 2. Development of Improved Methods for Harvesting, Processing and Transport of Forest Biomass for Energy from Conventional Forests. 3. Improvement of Methods for Converting Biomass Feedstocks into Usable Energy Forms. The Executive Committee has noted that: there has been considerable progress within all the ongoing Tasks during 1987; the planning of new Tasks for the period 1989 is well under way; and that there is an increasing interest in the IEA Bioenergy work from additional countries.

51386 **(TVA/OP/CEM—88/17) A report on TVA services to help customers improve their homes and businesses through the efficient use of electricity: Energy services report '87.** Davis, K.J.; Ireland, M.H. (eds.). (Tennessee Valley Authority, Chattanooga (USA). Div. of Conservation and Energy Management). 1987. 43p. NTIS, PC A03/MF A01. Order Number DE88016106/JAW.

This report provides information on the wide variety of energy services that were offered to customers in fiscal year 1987. The services are provided jointly by TVA and local distributors of TVA power. The purpose is to help customers take control of their energy costs and improve their lives through the efficient use of electricity. Residential, commercial and industrial, and demonstration programs are briefly discussed.

51387 **(UCRL—52000-88-5) Energy and Technology Review, May 1988.** Poggio, A.J. (ed.). (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015062/JAW.

This review of Lawrence Livermore National Laboratory's research programs includes: Measuring the Performance of Supercomputers; Microwave Tokamak Experiment; and Gas Cooling of Laser Disks. (JF)

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 50799, 50827, 51104, 51168, 51169, 51268, 51361, 51403, 51405

51388 **(DOE/ER—0370) Nuclear engineering enrollments and degrees, 1987.** (Oak Ridge Associated Universities, Inc., TN (USA)). May 1988. Contract AC05-76OR00033. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014532/JAW.

The "Nuclear Engineering Enrollments and Degrees Survey, 1987" was sent to 61 institutions with programs offering (1) a major in nuclear engineering or (2) an option in another engineering discipline (e.g., mechanical or chemical) with course work equivalent to a major in nuclear engineering that prepares graduates to function as nuclear engineers. Of the 61 institutions, numbers for one program were estimated based on past years' enrollments and degrees, and one institutions undergraduate program was reported as inapplicable. Four programs have been suspended; one awarded the last degrees in 1986, and three others suspended new enrollments but are allowing the current students to complete degrees. The number of nuclear engineering undergraduates and master's enrollments decreased in 1987; undergraduates by 37 students (3 percent) and master's by 13 students (2 percent). Sixteen institutions increased their doctoral enrollments by a total of 83 students, while other programs had decreases totaling 19 students, resulting in an overall increase of 64 doctoral students (12 percent). The total number of undergraduate degrees decreased by 63 students, or 11 percent. Doctoral degrees also decreased, by 23 students or 19 percent. Master's degree rose by 12, or by 4 percent.

51389 **(IEE-SR—189) Comparsion of shift to electric power in industries in U.S., Japan, and France.** (Institute of Energy Economics, Tokyo (Japan)). 30 Jun 1987. 76p. (In Japanese). NTIS (US Sales Only), PC A05. Order Number DE88752069/JAW.

The demand for electric power in iron and steel, paper, cement, and automobile industries in U.S., Japan and France were studied and compared. How far the demand for electric power increases by the adoption of advanced production processes is important, which must be studied. In U.S., the share of electric power in the total energy consumption increased, especially since 1973. In Japan, quite a defferent trend was observed. To see if technologies introduced in Japan might be different from those in U.S., trends of power consumption in 4 industries - iron and steel, paper, cement, automobiles - in U.S. and Japan were studied. Those which had important effects on power consumption were found to be the change in raw materials employed, substitution of fuel by electric power, new electric service facilities in plants, improvement of electrical efficiency, and the change in the utilization ratio of facilities. The

major factor for the different trend in U.S. and Japan was the higher cost of electric power in Japan. However, there are other causes such as different production growth rates, difference in climate and materials used, etc. (25 tabs, 73 refs)

51390 (INIS-mf—11696, pp 103-127) **What did change in the FRG after the Chernobyl reactor accident? On the situation in churches.** Seitz, M. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Inst. fuer Praktische Theologie). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

The author discusses in detail the implications of the reactor desaster of Chernobyl both in terms of social ethics and theology and demonstrates processes within the churches and official church statements.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 51393, 51551

51391 (DOE/CE/26558—T1) **District heating and cooling feasibility study for Dover, Delaware: Final report [September 2, 1986-May 31, 1988].** (Burns and Roe, Inc., Oradell, NJ (USA)). 11 Apr 1988. Contract FG01-86CE26558. 111p. NTIS, PC A06. Order Number DE88011594/JAW.

The following is a general description of the Burns & Roe study for Dover, Delaware. The study assesses the feasibility of district heating in Dover, Delaware, and develops a conceptual district heating system. The system would use the McKee Run Station, and a new boiler plant as the heat source, and the area surrounding the plant and the legislative areas as the heat load. The study assesses the available heat load for the city, determines the available heat from the McKee Run Station, and develops a conceptual distribution network and system implementation plan. The study analyzes the environmental impacts, institutional issues, and project economics of the conceptual system. 24 figs., 26 tabs.

2910 Conservation

REFER ALSO TO CITATION(S) 51354, 51411, 51501, 51502, 51512

51392 (CU—1980) **Consumer energy conservation options - professional and consumer perspectives.** Ritchie, B.J.R.; Claxton, J.D.; McDougall, G.H.G. (Calgary Univ., Alberta (Canada); British Columbia Univ., Vancouver (Canada); Wilfrid Laurier Univ., Waterloo, Ontario (Canada)). [1980]. 121p. (CE—01356). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objectives of this study were to: identify government policies for reducing Canadian consumption of home heating fuel, electricity, and gasoline; assess probable effectiveness of different policy alternatives as a means of reducing consumer energy consumption; and measure the acceptability to Canadian consumers of the different policy alternatives. Interviews were conducted with energy conservation professionals to identify and evaluate existing energy conservation programs, and interviews were conducted with consumers who had evaluated selected programs previously reviewed by the professionals. Information was also gathered on energy conservation activities of consumers surveyed. A directory of 34 energy conservation programs was also compiled. Some of the conclusions reached in this report are as follows. There is a need for an information system to gather data on existing conservation programs in order to increase the knowledge of relevant parties as to the outcomes of operating programs. This would help evaluation and improvement of current programs and suggest new program possibilities. The professionals rated six of the 34 programs highly, including the Energuide and the Canadian Home Insulation Program (CHIP). Retrofitting programs for houses are recommended for continuation and expansion, with some consideration given to linking these kinds of programs with home audit programs. In the private transport sector, any new conservation programs should be thoroughly tested on a small scale before widespread implementation, as evidence indicates that certain programs favorably evaluated by professionals may not be received favorably by consumers. 3 refs., 24 tabs.

51393 (ENR/SE—1987) **Energy Conservation and Renewable Energy Research, Development and Demonstration Program annual report, 1986/87.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). [1987]. 31p. (MICROLOG—88-03537). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The importance of energy conservation and renewable energy to Alberta's overall energy situation continues to be recognized and supported by the Alberta/Canada Energy Resources Research Fund. This support is reflected in the Energy Conservation and Renewable Energy Research, Development and Demonstration Program, which began in 1977 with research projects focusing on solar and wind energy. Since then, research, development and demonstation projects have been supported on such topics as geothermal energy, fusion energy, energy conservation in buildings, waste heat recovery and general energy conservation. Beginning in 1983/84, the program's emphasis shifted to three subjects, each of which became a separate subprogram area. These subprograms are in the areas of energy conservation in buildings, wind energy, and waste heat recovery/low temperature heat utilization. This report reviews the projects undertaken in these three subprograms. In addition, a technology transfer and dissemination project, which began during the last quarter of 1985/86, was responsible for raising the profile of the program and led to some suggestions for future projects.

51394 (ITC—82-122) **Small scale energy demonstration program.** (Industrial Technology Centre, Winnipeg, Manitoba (Canada)). Mar 1985. 119p. (CE—01877). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Sixty-six projects were sponsored under a program which provided funding assistance to individuals, small businesses, municipalities and non-profit organizations in Manitoba for the demonstration of conservation and renewable energy technologies. Projects approved and funded included heat pumps, energy management, waste heat recovery, wood heating, biomass and alternate fuels, active and passive solar, wind energy and solar greenhouses. Funding assistance varied between 50 and 75% of project costs to a maximum of $7,500. This report contains individual project summary sheets providing a description and economic analysis of each project. 49 figs.

51395 (MU/FAS—1983) **Consumer energy research: an annotated bibliography. Vol. 1.** Anderson, D.C.; McDougall, G.H.G. (Manitoba Univ., Winnipeg (Canada). Faculty of Administrative Studies; Wilfrid Laurier Univ., Waterloo, Ontario (Canada). School of Business and Economics). 1983. 372p. (CE—01886). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This annotated bibliography attempts to provide a comprehensive package of existing information in consumer related energy research. A concentrated effort was made to collect unpublished material as well as material from journals and other sources, including governments, utilities, research institutes and private firms. A deliberate effort was made to include agencies outside North America. For the most part the bibliography is limited to annotations of empirical studies. However, it includes a number of descriptive reports which appear to make a significant contribution to understanding consumers and energy use. The format of the annotations diplays the author, date of publication, title and source of the study. Annotations of empirical studies are divided into four parts: objectives, methods, variables and findings/implications. Care was taken

to provide a reasonable amount of detail in the annotations to enable the reader to understand the methodology, the results and the degree to which the implications of the study can be generalized to other situations. Studies are arranged alphabetically by author. The content of the studies reviewed is classified in a series of tables which are intended to provide a summary of sources, types and foci of the various studies. These tables are intended to aid researchers interested in specific topics to locate those studies most relevant to their work. The studies are categorized using a number of different classification criteria, for example, methodology used, type of energy form, type of policy initiative, and type of consumer activity. A general overview of the studies is also presented. 20 tabs.

51396 **(MU/FAS—8304) Consumer energy research: an annotated bibliography. Vol. 3.** Anderson, D.C.; McDougall, G.H.G. (Manitoba Univ., Winnipeg (Canada). Faculty of Administrative Studies; Wilfrid Laurier Univ., Waterloo, Ontario (Canada). School of Business and Economics). Apr 1983. Vp. (CE—01885). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This annotated bibliography attempts to provide a comprehensive package of existing information in consumer related energy research. A concentrated effort was made to collect unpublished material as well as material from journals and other sources, including governments, utilities research institutes and private firms. A deliberate effort was made to include agencies outside North America. For the most part the bibliography is limited to annotations of empiracal studies. However, it includes a number of descriptive reports which appear to make a significant contribution to understanding consumers and energy use. The format of the annotations displays the author, date of publication, title and source of the study. Annotations of empirical studies are divided into four parts: objectives, methods, variables and findings/implications. Care was taken to provide a reasonable amount of detail in the annotations to enable the reader to understand the methodology, the results and the degree to which the implications fo the study can be generalized to other situations. Studies are arranged alphabetically by author. The content of the studies reviewed is classified in a series of tables which are intended to provide a summary of sources, types and foci of the various studies. These tables are intended to aid researchers interested in specific topics to locate those studies most relevant to their work. The studies are categorized using a number of different classification criteria, for example, methodology used, type of energy form, type of policy initiative, and type of consumer activity. A general overview of the studies is also presented. 17 tabs.

51397 **(PB—88-212436/XAB) More with less: Managing Energy and Resource-Efficient Cities.** Bendavid-Val, A. (Agency for International Development, Washington, DC (USA)). 1987. 113p. (AID-PN-AAY—403). NTIS, PC A06/MF A01.

The report describes the Managing Energy and Resource Efficient Cities (MEREC) project and demonstrations in three cities. A summary of lessons learned from the demonstrations is provided. Information especially useful to policy makers and program managers is provided.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 50633, 50642, 50668, 51355, 51356, 51358, 51359, 51360, 51401, 51405, 51414, 51419, 51420, 51429, 51430, 51512

51398 **(DOE/EIA—0035(88/05)) Monthly energy review, May 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Aug 1988. 143p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88016822/JAW.

Information is presented on supply, demand, consumption rate and price for the following: petroleum, natural gas, coal, electric utilities, and nuclear power. A total energy overview is also presented. (CBS)

51399 **(DOE/FE—0101-2) Strategic petroleum reserve: Quarterly report.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Petroleum Reserves). 15 Aug 1988. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016852/JAW.

This report describes activities undertaken with respect to the development of the Reserve. The introduction and summary briefly discuss program background and major activities of the quarter. Section II describes site development. Oil acquisition activities are reported in Section III. Information on the budget and cost of the Reserve is contained in Section IV. Strategic Petroleum Reserve storage capacity reached 581.3 million barrels. The total inventory of crude oil stored in the Strategic Petroleum Reserve reached 550, 055,724 barrels. The average fill rate during the quarter was 56,239 barrels per day, and the weighted average delivered price during this quarter was $15.99 per barrel. The average fill rate through the third quarter of fiscal year 1988 was 59,000 barrels per day. Funds available for obligation in fiscal year 1988 include $439 million in the SPR Petroleum Account for the acquisition and transportation of crude oil and $232 million in the Strategic Petroleum Reserve Account for activities associated with storage facilities development and the operation and management of the Strategic Petroleum Reserve.

51400 **(NP—8770414) Perspectives of energy supply. Possibilities of restructuring energy supply in Baden-Wuerttemberg with particular regard to electric power supply. Expertise on behalf of the State Government of Baden-Wuerttemberg. Overall report.** Voss, A. (ed.). (Stuttgart Univ. (Germany, F.R.)). (Stuttgart Univ. (Germany, F.R.)). Nov 1987. 581p. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88770414/JAW.

In 1986, the State Government of Baden-Wuerttemberg ordered an expertise with the objective of extensively analysing the technically feasible ways of achieving long-term guarantee for energy supply in Baden Wuerttemberg; they should also be assessed with regard to their ecological, economic, and social impacts; one of the main concerns of the expertise was to find out if, and to which extent and with which steps, the use of nuclear energy can be eliminated and which consequences would be connected with this. Basing on the present level of knowledge, the expertise is expected to provide the necessary fundamentals of the process of assessing the use and risks of various technically feasible designs of Baden-Wuerttemberg's future energy supply. The article presents the results of the intensive research which took more than a year.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 51212, 51215, 51354, 51358, 51362, 51371, 51372, 51392, 51926, 52412, 52898

51401 **(AFLW—8703) Alberta Energy annual report, 1986/87.** (Alberta Dept. of Forestry, Lands and Wildlife, Edmonton (Canada). Public Lands Div.). 31 Mar 1987. 29p. (MICROLOG—88-03264). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Alberta Department of Energy is responsible for managing the province's energy resources. It applies sound management practices to encourage development of these resources and obtain a fair return of revenue to the province. In carrying out its mandate, the department administers several acts governing the development of energy resouces, including the Mines and Minerals Act, Mineral Titles Redemption Act, freehold Mineral Rights Tax Act, and Petroleum incentives Program Act. The department is organized into two sectors: Energy Resources and Finance and Administration. Energy Resources is made up of five divisions: Policy Analysis and Planning, Mineral Resources, Scientific and Engineering Services, Petroleum Incentive Programs, and Legal Services. Finance and Administration contains five divisions: Automated Information Systems, Mineral Revenues, Human Resources, Finance and General Services, and Internal Audit. In this report major departmental activities, including activities aimed at promoting technology devel-

opment as well as developing and implementing programs on the efficient use of energy, are described under seven board categories: policy initiatives, mineral resource management, research and technology development, Alberta Oil Sands Equity, energy conservation, mineral revenues and departmental support services.

51402 **(CONF-8802100—) Activities of the Commission, 1987.** (Baltic Marine Environment Protection Commission, Helsinki (Finland)). Feb 1988. 170p. NTIS (US Sales Only), PC A09; 1; GPO Dep. Order Number DE88015628/JAW.

From 9. meeting of the Baltic Marine Environment Protection Commission; Helsinki, Finland (15 Feb 1988).

During the eight year of operation of the Helsinki Commission (HELCOM) the elaboration of further measures against pollution was continued. The outcome of the eighth meeting of the Commission held in Helsinki 24--27 February 1987 has been published in the Baltic Sea Environment Proceedings No. 23. Detailed information on the progress made since the eighth meeting of the Commission in the different substantive activities within the framework of the Baltic Marine Environment Protection Commission is given.

51403 **(DOE/RW—0189) Office of Civilian Radioactive Waste Management annual report to Congress.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Aug 1988. 65p. H. Order Number TI88016123/JAW.

This is the fifth Annual Report to Congress by the Office of Civilian Radioactive Waste Management (OCRWM). The report covers the activities and expenditures of OCRWM during fiscal year 1987, which ended on September 30, 1987. The activities and accomplishments of OCRWM during fiscal year 1987 are discussed in chapters 1 through 9 of this report. The audited financial statements of the Nuclear Waste Fund are provided in chapter 10. Since the close of the fiscal year, a number of significant events have occurred. Foremost among them was the passage of the Nuclear Waste Policy Amendments Act of 1987 (Amendments Act) on December 21, 1987, nearly 3 months after the end of the fiscal year covered by this report. As a result, some of the plans and activities discussed in chapters 1 through 9 are currently undergoing significant change or are being discontinued. Most prominent among the provisions of the Amendments Act is the designation of Yucca Mountain, Nevada, as the only candidate first repository site to be characterized. Therefore, the site characterization plans for Deaf Smith, Texas, and Hanford, Washington, discussed in chapter 3, will not be issued. The refocusing of the waste management program under the Amendments Act is highlighted in the epilogue, chapter 11. 68 refs., 7 figs., 7 tabs.

51404 **(EFN—23) Demonstration and experimental designs. An evaluation by means of case studies of government support of full-scale projects on the energy field.** (Energiforskningsnaemnden, Stockholm (Sweden)). Dec 1986. 206p. (In Swedish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754395/JAW.

This evaluation concerns full-scale plants or installations to be used by normal customers, i.e. by users of energy systems under commercial conditions. The conclusions below derive from fifteen case studies. The case studies are selected from the three major governmental programmes: -Prototype and demonstration support administrated by the National Energy Administration (and its predecessors), - Full-scale experimental activities in buildings supported by the Swedish Council for Building Research, - The project for heat pumps and solar heating at the Swedish State Power Board. The case studies include projects concerning the following energy technologies: Heat pumps of various sizes, industrial process-heat recovery, circulating fluidized bed (CFB) boiler, timber drying, flue gas condensation, a solar heating central, and energy conservation methods for buildings.

51405 **(INIS-mf—11778) Economically efficient energy generation and energy utilization: Potentials as well as effects in terms of energy, ecology, economy. Summarizing report.** Masuhr, K.P. (Prognos A.G., Koeln (Germany, F.R.); Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.)). 18 Sep 1987. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754652/JAW.

As the electric power industry is closely interlaced with the overall power supply system of the country, and especially with the heat market, a study into the impacts of an abandonment of nuclear power is necessary in order to be able to assess the situation in the energy sector at large. The report in hand summarizes the methodology adopted and the frame conditions taken as a basis. The contrast scenario without nuclear energy is explained and interpreted in terms of its effects on the energy market, the economy and the environment.

51406 **(INIS-mf—11788) Law on Precautionary Radiation Protection prevents public health protection. A speech delivered to the Bundesrat by the Hessian Minister of Social Affairs, Mr. Armin Clauss (SPD), on November 7, 1986.** Clauss, A. (Hessisches Sozialministerium, Wiesbaden (Germany, F.R.)). 7 Nov 1986. 143p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754340/JAW.

On the occasion of the discussion by the German Bundesrat of the bill on Precautionary Radiation Protection, the Hessian Minister of Social Affairs denied his approval of the bill on the grounds that there are serious and numerous flaws. He considered the bill to be a more dummy put up for election propaganda; as he could not find any substantive provisions in it. The Minister in his speech explained this opinion, saying that the bill does not provide for the protection of public health, nor create the necessary conditions for an effective and coordinated emergency control in case of a radiation accident. He declared the bill to be just an instrument of warding off danger that in essence curtails important rights of participation of the Laender. (HSCH).

51407 **(LA—11399-MS) The future of nuclear weapons: The next three decades: Conference summary.** Garrity, P.J.; Pendley, R.E.; Selden, R.W. (Los Alamos National Lab., NM (USA). Center for National Security Studies). Jul 1988. Contract W-7405-ENG-36. 17p. (CONF-8806206—Summ.; CNSS/Papers—16). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015364/JAW.

From Conference on the future of nuclear weapons: the next three decades; Los Alamos, NM, USA (6 Jun 1988).

An overview is presented of a conference held at the Los Alamos National Laboratory, June 6-8, 1988, on The Future of Nuclear Weapons: The Next Three Decades. The conference was sponsored by the Laboratory's Center for National Security Studies.

51408 **(NEI-DK—92) Long term energy planning in Denmark - a sustainable option.** Noergaard, J.S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Aug 1987. 21p. (CONF-8708274—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754406/JAW.

From Brasilcon 87: 1st international congress on energy; Sao Paulo, Brazil (19 Aug 1987).

This paper focuses on describing a possible future development in Denmark, which as far as energy and economy is concerned, deviates significantly from what the official government energy plans imply. It is, however, a sustainable and humane future scenario which seems in pretty good accordance with the wishes and interests of the majority of Danes. The sustainable future presented is not a prognosis or a mechanistic forecast of what is most likely to happen in Denmark. It is a scenario, meaning a consistent and coherent development in attitudes, social structure and technology, which the Danish people can choose, if they want to. The basic principles of this sustainable and humane energy scenario for Denmark can be applied to any country in the world. 14 refs.

51409 **(OEB—88) Ontario Energy Board annual report 1986/87.** (Ontario Energy Board, Toronto (Canada)). 31 Mar 1987. 30p. Ontario Energy Board, 14 Carlton St., 9th Floor, Toronto, Ont., Canada M5B 1J2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Ontario Energy Board is the provincial agency responsible for regulating the province's major energy industries, natural gas and electricity. The Board regulates the provincial natural gas industry in a variety of ways including rate setting, approval of franchise agreements and authorizing the installation of transmission lines. The Board also acts as an advisor to the Minister of Energy on matters relating to the natural gas industry as well as Ontario Hydro. The Board makes recommendations with respect to any proposed Hydro rate increases. Several of these responsibilities are described in greater detail in this report. Also included are summaries of the major decisions taken by the Board during the year. These decisions relate to such matters as gas storage facilities, corporate takeovers of utilities, expansions of service and rate structures. An outline of the public hearing process is included.

51410 **(WHC-EP—0088) UNC Nuclear Industries reactor and fuels production facilities 1986 effluent release report.** Rokkan, D.J. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 12 May 1987. Contract AC06-87RL10930. 33p. (UNI—4370). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015602/JAW.

Analyses of routine samples from radioactive liquid and airborne streams were performed using UNC's Radioanalytical Laboratory and the analytical services of US Testing Company. Analyses of nonradioactive constituents were performed mainly in the laboratories of the Hanford Environmental Health Foundation, and a smaller number by the Pacific Northwest Laboratories labs in the 300 Area. The CY 1986 results from UNC's effluent sampling and analysis program indicate that all effluent releases were within UNC Technical Specification limits; releases of ^{90}Sr via the riverbank springs, or N Springs, totaled 7.9 Ci for CY 1986, while averaging 5900 pCi/L; for CY 1986, 36 Ci of ^{90}Sr were discharged to the 1325-N LWDF; and the ^{131}I and ^{60}Co releases via the N Springs decreased greatly in CY 1986 as compared to the releases of CY 1985.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 50634, 50637, 50638, 50639, 50642, 50668, 50674, 51360, 51363, 51398, 51409, 51423

51411 **(A/ENR—1984) Alberta/Canada Energy Resources Research Fund Program summary of projects, April 1, 1983 - June 30, 1983.** (Alberta Energy and Natural Resources, Edmonton (Canada)). 1 Apr 1983. 17p. (CE—01871). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Research programs described in this report include hydrocarbon research, capital spending on a building for an energy resources office and laboratory, and coal research projects involving coal mining, conversion, and pipelining. Energy conservation and renewable energy projects are also described in the fields of solar and wind energy, energy efficient houses, and building components such as fireplaces and roofs. Includes list of unsolicited proposals, university programs, and research reports published. 22 refs., 3 tabs.

51412 **(AE/P—162) Alberta Petroleum Incentives Program Fund annual report, 1985/86.** (Alberta Energy, Edmonton (Canada). Petroleum Div.). [1987]. 9p. (MICROLOG—88-03267). Alberta Petroleum Incentives Program Fund, Communications Section, 855 - 8th Ave., SW, Calgary, Alta., Canada T2P 3P1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Alberta Petroleum Incentives Program (APIP) was created in November 1981. APIP's objective is to encourage the exploration and development of Alberta's petroleum and natural gas resources. The program also supports work on tertiary oil recovery projects. Under the program, eligible applicants may obtain APIP incentive payments equal to a percentage of their incurred eligible costs and expenses, including exploration and development expenses for oil and gas wells; geological and geophysical expenses, and development drilling and asset costs related to teriary oil recovery projects. The APIP office is in Calgary , where the majority of headquarter operations associated with Alberta's oil and gas industry are located. This report of the year's activities includes a summary of incentives paid and the financial statements of the APIP Fund.

51413 **(COGLA—8803) Environment Studies Research Funds annual report, 1987.** (Canada Oil and Las Lands Administration, Ottawa, Ontario). Mar 1988. 18p. (MICROLOG—88-02963). Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Initiated in 1983, the Environmental Studies Research Funds (ESRF) is a program of funding for environmental and social studies related to oil and gas development on Canadian frontier lands. A focussed program, it deals exclusively with research to assist in decision-making related to oil and gas exploration and development. Funding for the ESRF is provided through levies on the oil and gas companies that hold interests on frontier lands. Administration is provided by the federal government. The operation of the ESRF is a multi-disciplinary, cooperative effort among specialists from federal, provincial and territorial governments, the oil and gas industry, universities and the private sector. The bulk of the technical work of the ESRF is performed by a series of Program Study Committees who provide expert advice in priority subject areas identified by the Board. These committees are comprised of scientific and technical experts from the oil and gas industry and the federal, provincial and territorial governments. This report summarizes the year's activities of the ESRF and includes descriptions of current research projects and a list of publications.

51414 **(EMR—8802) Response to the eighth report of the Standing Committee on Energy, Mines and Resources: oil scarcity or security?.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Feb 1988. 30p. (In English and French). (MICROLOG—88-03434). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The report to which this document is a response contains an extensive discussion of how the world energy picture, and the petroleum situation in particular, has evolved during this century. The Committee's view was that the essential nature of petroleum, combined with the geographic disparity between supply and demand and the huge difference in production costs between eastern and western sources, mandate that governments must view oil as a strategic good, and develop policies to ensure that the available supply of oil will not fall short of the economy's needs. That report also noted measures considered in the USA to ensure continued oil availability in case of a crisis, points out the major regional imbalances in Canadian energy production and consumption, and the present and potential future state of the Canadian oil situation. In this document, the Government finds there are a few fundamental differences in objectives between the report and its own view of energy policy. Where differences do exist, they are more a matter of emphasis and choice of approach than a basic difference in views. This document presents an overview of Canadian energy policy in comparison to the philosophy advanced by the report, then develops the implications of current policy for specific issues of concern to the Committee: security of supply, megaprojects, and alternative energy and conservation. Specific responses to each of the Committee's twelve recommendations are made. These recommendations include establishment of a strategic oil reserve.

51415 **(GOGLA—8803) Environmental Studies Research Funds annual report, 1987.** (Canada Oil and Las Lands Administration, Ottawa, Ontario). Mar 1988. 25p. (In French). (MICROLOG—88-02963). Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, Ont., Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Initiated in 1983, the Environmental Studies Research Funds (ESRF) is a program of funding for environmental and social studies related to oil and gas development on Canadian frontier lands. A focussed program, it deals exclusively with research to assist in decision-making related to oil and gas exploration and development. Funding for the ESRF is provided through levies on the oil and gas companies that hold interests on frontier lands. Administration is provided by the federal government. The operation of the ESRF is a multi-disciplinary, cooperative effort among specialists from federal, provincial and territorial governments, the oil and gas industry, universities and the private sector. The bulk of the technical work of the ESRF is performed by a series of Program Study Committees who provide expert advice in priority subject areas identified by the Baord. These committees are comprised of scientific and technical experts from the oil and gas industry and the federal, provincial and territorial governments. This report summarizes the year's activities of the ESRF and includes descriptions of current research projects and a list of publications.

51416 **(IEE-SR—188) Report on supply and demand trend of energy for short term.** (Institute of Energy Economics, Tokyo (Japan)). Jun 1987. 113p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752070/JAW.

The changes in the energy situation in 1986 has been put in order and reported. It was assumed that the supply of the primary energy in 1986 was less than the previous year (-0.6%) after 4 years since 1982. The supply of coal was less than the previous year (-4.2%) after 6 years since 1980. Private generated power which constituted about 10% of the power demand and occupied approximately 30% of the power for large industiral users increased by 10-15% because of its high econmical efficiency due to low costs of oil, coal, etc. This resulted in 1-1.5% decrease in the electric power sold by the power utility companies. The demand for city gas increased by 3.1% due to the increase in newly built office buildings. Consequently, the growth of sales of city gas was the highest. Production in iron and steel, paper, petrochemical products, cement and automobile industries was reported together with detailed data for the forecast of the demand. (13 figs, 59 tabs)

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 50886

2960 Electric Power

REFER ALSO TO CITATION(S) 51357, 51363, 51409, 51429, 51434, 52146, 52147

51417 **(BCH/RD—8802) B.C. Hydro's collection of residential accounts.** Bell, L.; Owen, S. (British Columbia Hydro and Power Authority, Vancouver (Canada)). Feb 1988. 69p. (MICROLOG—88-02613). Residential and Commercial Energy Management, B.C. Hydro, 3 - 1265 Howe Street, Vancouver, B.C., Canada V6Z 2C8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study focuses on the two major functions performed by British Columbia Hydro collection personnel: determining responsibility for outstanding accounts, and taking collection action on those accounts. The objectives of the study were to describe selected features of Hydro's current collection practices, to examine the reasons that Hydro personnel use to support those practices, to evaluate the legality and fairness of those practices and reasons, make proposals for the enhancement of a comprehensive, fair, and legally sound written policy and procedure, and to propose ways of increasing the effectiveness of Hydro's collection system. Data for the study were obtained from collection complaint files, Hydro documents, interviews, questionnaires, and examination of the statute and case law relevant to the performance of collection functions. The main findings of the study were as follows. The degree of variation in collection proactives, particularly concerning the assessment of liability for accounts, is considerable. It would appear that a significant proportion of collection staff could benefit from greater knowledge of relevent law and policy related to their work. The current written policies and procedures concerning collections are not sufficiently complete to provide the guidance necessary to ensure fair and equal treatment of all Hydro customers. Collection success might be improved with certain enhancements to account management procedures. Hydro has the personnel resources to handle a higher proportion of complaints and disputes without the need for third party intervention, but it lacks the appropriate formal procedures. Recommendations are made for development of appropriate policies and procedures.

51418 **(DOE/EIA—0095(87)) Inventory of power plants in the United States, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 17 Aug 1988. 293p. NTIS, PC A13/MF A01 - GPO; 1; GPO Dep. Order Number DE88015698/JAW.

Coal-fired capacity accounts for the greatest share of the capacity of power plants operated by the nation's electric utilities. Coal- fired capacity (including lignite) accounted for 43.4 percent of total operable capacity, as of year-end 1987. Gas-fired capacity ranked next, accounting for 17.5 percent of operable capacity; nuclear, 13.9 percent; hydroelectric, 13.3 percent; petroleum-fired, 11.3 percent; and other, 0.6 percent. Conventional steam- electric plants accounted for 65.3 percent, or 440,328 megawatts of operable capacity at the end of 1987. The 440,328 megawatts of conventional steam-electric capacity include 292,595 megawatts of coal-fired capacity; 49,869 megawatts of petroleum-fired capacity; and, 95,479 megawatts of gas-fired capacity. The remaining 2385 megawatts are in units primarily using waste heat or steam, refuse, and wood. 14 figs., 26 tabs.

51419 **(DOE/EIA—0474(88)) Annual outlook for US electric power 1988: Projections through 2000.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1988. 83p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. Order Number DE88016825/JAW.

The projections for electricity supply and demand in this report are based on the assumptions contained in the Annual Energy Outlook 1987 (AEO). In that report, total energy consumption is projected to grow an annual rate of 1.3 percent between 1987 and 2000. By contrast, demand for electricity is projected to grow at an annual rate of 2.4 percent. This growth in electricity demand accounts for about 52 percent of the increase in total end-use demand for energy. Electricity generation is expected to grow from 36 percent of primary energy consumption in 1987 to 42 percent in 2000. This significant share of total energy requirements is expected to be met by conventional sources, such as coal and nuclear plants owned by electric utilities, as well as by other sources, including cogenerators and small power producers and imported electricity (principally from Canada). Electricity prices are expected to remain stable compound with other fuels through 2000. 7 figs., 12 tabs.

51420 **(EPRI-EL—5851-Vol.1) RISKMIN: An approach to risk evaluation in electric resource planning: Volume 1, Methodology: Final report.** Bhavaraju, M.P.; Chamberlin, T.C.; Nour, N.E. (Electric Power Research Inst., Palo Alto, CA (USA); Public Service Electric and Gas Co., Newark, NJ (USA)). Aug 1988. 113p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016991/JAW.

The primary objective of the work was to develop a method to trade off multiple, conflicting attributes and to identify plans which are robust under specified uncertainties. Building on a previously reported trade off method in the project EPRI RP1960, "An Approach to Determining Transfer Capability Objectives", this cur-

rent work developed a method and software to meet the project objective. It was applied to three case studies to identify the robust plans and options. The software can produce special reports which can indicate large variations in attributes of a plan under uncertainties and thus the risk associated with the plan. The project report describes the methodology and case studies (volume 1) and provides guidelines to use the software (volume 2). 34 refs., 14 figs., 13 tabs.

51421 **(HQ—87) Hydro-Quebec a valuable partner.** (Hydro-Quebec, Montreal (Canada)). 1987. 79p. (In English and French). (MICROLOG—88-02998). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document is aimed at those interested in doing buisiness with Hydro-Quebec. It gives a brief history of this electric utility, a description of its geographical location, and its role as a power source in Quebec and neighboring areas. Advantages of a Quebec location for businesses using electricity are discussed, centering on the act that 97% of electric power in Quebec is hydroelectric. Services of Hydro-Quebec are outlined, including feasibility studies, technical and financial assistance, marketing programs, plant site selection, research and development facilities, export and interconnection capabilities, consulting services, and environmenmental managment. 37 figs.

51422 **(HQ—87) [Hydro-Quebec] Environmental Office.** (Hydro-Quebec, Montreal (Canada)). [1987]. 30p. (In French). (MICROLOG—88-03412). Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, P.Q., Canada H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The document outlines the capabilities of Hydro-Quebec's environmental section. This section has the responsibility for impact studies, ensuring the protection and conservation of the environment during construction, operation, and maintenance of Hydro-Quebec's installations, carrying out research and development programs, and defining the directives, standards, and practices that assure minimal environmental impact. The section performs contract work including impact studies, socio-economic analyses, laboratory work and computer analyses. Its expertise is in planning, conceiving and managing environmental studies related to electric power. 18 figs.

51423 **(KTM/E-D—151) Alternatives to utilize natural gas in power production.** Halme, J.; Jaervinen, M.; Lehdonvirta, H.; Vaeisaenen, P. (Ekono, Helsinki (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Mar 1988. 92p. (In Finnish). NTIS (US Sales Only), PC A05. Order Number DE88754405/JAW.

The object of the study has been to find out the technical and economical feasibility of different power plant processes using natural gas. The following companies have been used as exemplary cases: Oy Nokia Ab, Espoon Saehkoe Oy and Myllykoski Oy. Industry: The combi process gives an opportunity to increase the power production capacity in industry with about 200-400 MW and the back pressure power production with about 2-3 TWh/a. The capacity can be further increased with about 50-100 MW by dimensioning the gas turbines for additional condense production. Thus, the additional power production, condense power included, could be about 3-4 TWh/a. The most feasible process alternative seems to be /sup a/ normal combi plant/sup /i.e. a gas turbine - combi boiler - steam turbine, both in back pressure as well as in condense production. The power production is economically feasible, if the gas price is less than 40-50 FIM/MWh when compared with the H/85 whole sales pricing system. On the other hand, the gas price should be less than 55-60 FIM/MWh, if the combi production is compared with new coal condense plants. Municipal energy: The combi process is technically and economically feasible also in municipal energy supply, which is proved, in addition to the calculations in this study, by the numerous power plant decisions lately. The most feasible process alternatives seem to be a normal combi plant, a gas turbine-waste heat boiler and a gas turbine connected to the feed water preheating system. The total capacity of the existing and decided plants is about 600 MW, corresponding to an annual production of 2.5-3.5 TWh. The additional potential is about 400-600 MW and 2-3 TWh/a. The realization of the potential is affected i.a. by the following factors: the price of the gas, the price development of fuels and power, the possible limitations in the availability of gas, the criteria applied to profitableness, the level and time schedule of NO/sub x/-limits.

51424 **(ME—87) Maritime Electric Co. Ltd. annual report, 1987.** (Martec Ltd., Halifax, Nova Scotia (Canada)). 1987. 20p. (MICROLOG—88-03364). Maritime Electric Co. Ltd., Confederation Court Mall, 134 Kent St., Charlottetown, P.E.I., Canada C1A 7N2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Maritime Electric Company is a Canadian investor-owned electric utility based in Prince Edward Island. Established in 1918, the Company owns and operates a fully integrated system providing for the generation, transmission and distribution of electricity throughout the Island. Maritime Electric operates generating plants in Charlottetown and Borden, and has an equity interest in NB Power's unit in Dalhousie, New Brunswick. Its 4,100 km distribution system and 500 km transmission system are linked to the mainland power grid by two submarine cables between the Island and the province of New Brunswick. This report describes the Company's operations, power production and sales for the year, with relevant statistical information. Financial statements are also included.

51425 **(NBEPC—8706) [New Brunswick Electric Power Commission] Fifteen year load forecast, 1987-2002.** (New Brunswick Electric Power Commission, Fredericton (Canada)). Jun 1987. Vp. (MICROLOG—88-03591). New Brunswick Electric Power Commission, 515 King St., Fredericton, N.B., Canada E3B 4X1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document presents a fifteen year forecast of the electric requirements of the in-province customers of the New Brunswick Electric Power Commission. The load forecast is prepared each year based on a cause and effect analysis of past loads, combined with data gathered through customer surveys and an assessment of economic, demographic, technological and other factors which affect the utilization of electrical energy. In addition to the forecast requirements of each sales classification and total energy supply by month, this document includes a forecast of the monthly peak hour demand (the maximum amount of energy required in a one hour period). The forecast results are used in overall short and long term planning, particularly the financial and facilities planning. The actual experience is likely to differ from the forecast and such differences are likely to be larger in the later years. Variations from the forecast can significantly affect the future financial and facilities requirements. Therfore this document includes a forecast range which provides a sensitivity of the forecast to various input parameters and their resulting impact on the final results.

51426 **(SPC—1987) SaskPower annual report, 1987.** Hill, G.D. (Saskatchewan Power Corp., Regina (Canada)). 1987. 32p. (MICROLOG—88-03479). Saskatchewan Power Corporation, 2025 Victoria Ave., Regina, Sask., Canada S4P 0S1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

SaskPower is a provincially owned Crown Corporation, established in 1949 to provide electricity and natural gas to the residents of Saskatchewan. SaskPower's primary objective is to meet the natural gas and electrical energy needs of Saskatchewan residents in an economical, safe reliable, efficient and environmentally responsible manner. This service is to be provided at rates that cover all costs and contribute to short- and long-term financial health of the corporation. SaskPower's board of directors is a pointed by the provincial government and represents a broad spectrum of Saskatchewan residents. This report presents relative production and consumption statistics relating to gas and electricity

operations, as well as the years developments in management and service practices. Financial statements are also included.

51427 **(TVA/PUB—88/5) Load forecast and power supply summary, fiscal year 1989.** (Tennessee Valley Authority, Chattanooga (USA). Power Planning Staff). Jul 1988. 130p. NTIS, PC A07/MF A01. Order Number DE88016075/JAW.

The positive impact of economic growth and TVA's policy of holding rates constant for three years will be significant factors causing future growth in electricity sales. Residential, commercial, and distributor-served industrial sales are expected to grow at 2.7 percent per year from 1987 to 2005. The directly served industrial load is expected to increase slightly over the forecast period. TVA has 24,590 MW of system capacity to meet the 1988 summer peak load. The low operating cost resources, hydro and nuclear, are used to the fullest extent available. Coal-fired capacity is the next lowest cost power resource but is only used to the extent necessitated by power system demand. Pumped storage capacity is used to meet peak demands since its energy output is limited by the size of the reservoir. The highest cost resource is combustion turbine capacity which is used only to meet peak demands on the power system. Cogeneration, T-O-D rates, and interruptible rate agreements provide additional equivalent capacity for the power system by reducing demand. The winter peak and summer peak equivalent capacity in the 1989 load forecasts are shown in table 14. With the medium estimate, cogeneration, T-O-D rates, and industrial interruptible load impacts, which include 5-percent interruptible and limited interruptible, will provide 1104 MW of additional equivalent capacity in the winter and 1096 MW in the summer for the year 1995. By 2005 the additional equivalent capacity in the winter is expected to be 1417 MW and the summer amount is 1409 MW. Comparing the system peak demand or load with the available supply indicates the capability of the power system to meet the peak demand requirements.

51428 **(TVA/PUB—88/10) Evolution and status of the TVA Power System, 1987.** (Tennessee Valley Authority, Chattanooga (USA). Office of Power). 28 Aug 1987. 101p. NTIS, PC A06/MF A01. Order Number DE88016073/JAW.

The decisions that led TVA into the most ambitious nuclear power construction program in the country were based on judgments about future power needs and power supply options that were widespread in the electric utility industry at that time. They also reflected the size and nature of the market for TVA power, its history of successful expansion to meet growing demands, and its commitment to supply power for uranium enrichment needs then foreseen by the Federal Government and the utility industry. The two-year shutdown of TVA's nuclear plants has raised a variety of questions about the status and visibility of its power system. However, this review of various aspects of the TVA power program shows that, on balance, the overall program is sound and capable of continuing its mission to serve the needs of the Tennessee Valley region. After a wholesale overhaul of the nuclear organization, and a massive amount of complex engineering work, the nuclear recovery program is moving toward expected resumption of operations in coming months. The three priority units for restart may all be operating by the end of 1988. The fossil and hydroelectric power facilities continue to produce power efficiently. The fossil system's record 85-billion kilowatthour performance in 1986 is evidence of that. TVA is in the second year of a multi-year effort to identify and make capital improvements in its fossil and hydro facilities to assure their long-term operational reliability at lowest possible cost. TVA's energy conservation program is one of the largest and most successful in the utility industry. It is benefiting participating consumers by reducing power bills, and contributing to the future delay of the need to begin planning additional costly future generating capacity.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 50632, 51389, 51395, 51396, 51398, 52082

51429 **(ESC-WR—88-03) The model for consumption of electricity in the Netherlands in detail.** Van den Wijngaart, R.A.; Blok, K.; Albers, R.; Ter Horst, E.W.; Turkenburg, W.C. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Mar 1988. 33p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In a preceding exploratory study it has been investigated how the present consumption pattern of electricity was subdivided in patterns per sector. This follow-up study investigates the consumption pattern of a few sectors more detailed. The report at hand gives an account of research aimed at getting a better insight in the consumption of electricity in different sectors. The purpose of this is to create a better reconstruction of the hourly pattern in the total public consumption of electricity in the Netherlands. Starting from a division of the consumption per sector, the computer model PKS to compose and to sum patterns, and the daily, weekly and annual patterns for the different sectors, we arrive at a designed total pattern that will be compared with the realized total pattern. The adaptations resulted in a concordance of the constructed and the realized pattern. However the intended accuracy could not be realized. It is not to be expected that extension of the investigation on this basis will produce significant improvements. More knowledge about consumption patterns demands extended measurement programs in the domestic sector and especially in the office sector. 4 figs., 63 refs., 7 tabs.

51430 **(IEE-IC—84) How to read an energy balance table, with problems invalued.** (Institute of Energy Economics, Tokyo (Japan)). 15 May 1987. 45p. (In Japanese). Inst. of Energy Economics, 1-18-1, Toranomon, Minato-ku, Tokyo.

On the basis of past studies on the Energy Balance Table, the Inst. of Energy Economics has set a theme; Study on the Energy Demand/Supply Data; as a project for 1986. During the development of the study work, mainly because of the time limitation of the committee management, this report is published in the form of a collection of individual report. Firstly the construction of the Energy Balance Table and the reading guide are explained. Among the problems involved in the Balance Table, the relatively easy ones are picked up, and the result of improvement is checked against the figures of the present table. Lastly, such problems as uncounted energy, energy distribution, private power generation, etc. are described regardless of the prospect for the problem solving. (2 figs, 15 tabs, 3 refs)

51431 **(IEE-SR—187) Comparison on structure of industrial energy consumption among Japan, U.S. and European countries.** (Institute of Energy Economics, Tokyo (Japan)). 15 May 1987. 252p. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88770171/JAW.

The oil price continued to drop in 1986, spot price, at one time, having come down below 10 dollars barrel (FOB). In order to analyze how the rapid drop of oil price would influence the industrial energy consumption and the fuel selection, comparison of industrial energy consumption structure among Japan and the four countries, U.S.A., U.K., France and West Germany, was made under the intention to point out the uniqueness of Japan. The study was made on the demand and supply and price structure, and on the factorial experiment of energy consumption since the time of oil crisis until the recent time. Energy consumption structure was scrutinized especially for the steel industry, pulp and paper industry, and cement industry. (63 figs, 34 tabs, 5 refs)

51432 **(ORNL—6433) Energy use and fuel substitution in economic development: What happened in developed countries and what might be expected in developing countries?.** Jones, D.W. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015321/JAW.

This paper begins with such a re-examination of developed countries' historical experiences with structural changes in energy

sources and uses, in aggregate terms and, where possible, on sector- and fuel-specific bases. It then draws together comparable evidence on developing countries in an effort to assess similarities and differences in situations and experiences. Particular attention is paid to evidence of fuel substitution in the household sector, which is especially important in developing countries but has received relatively scant attention in historical studies of the developed countries. The practice of omitting wood energy from measures of the energy intensity of output, on the grounds that most wood energy is used in the household sector and that including it distorts the impression given of changes in productive energy intensity, may be a reasonable simplification for some purposes, but it may distort the insights that developed country experience can offer for current, developing country prospects. 60 refs, 8 figs, 17 tabs.

51433 **(TVA/OP/EUDR—88/1) Statistics: Distributors of TVA Power: Fiscal years 1983--1987.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Use and Distributor Relations). 1987. 190p. NTIS, PC A09/MF A01. Order Number DE88016100/JAW.

Statistical data for TVA power distributors is presented. Degree-days for the winter of 1986--87 were 8 percent less than normal but were 5 percent more than the previous winter. Residential average use increased from 13,476 kWh to 14,081 kWh (the all-time high of 16,251 kWh occurred in fiscal year 1978). Despite continued warmer winter weather, customer load growth caused total sales by the distributors to increase by 6 percent during fiscal year 1987. Including the effects of the October 1986 Rate Change and Adjustment Addendum, revenue per kWh increased by 7 percent and power cost per kWh increased by 6 percent. Operation and maintenance expenses per consumer for all distributors increased 5 percent in 1987. Operation and maintenance expenses per consumer for the four largest municipalities and cooperatives increased 5 percent, while expenses per consumer for the smaller municipalities increased by 6 percent. On a per-kWh-basis, operating expenses for all distributors increased 2 percent. The four largest municipalities showed a 2-percent increase, the smaller municipalities a 3-percent increase, and the cooperatives a 1-percent increase.

51434 **(TVA/OP/PINFO—88/7) Financial and statistical report for municipal and cooperative distributors of TVA power: Volume 2, 1987 power program summary: Fiscal year ending June 30, 1987.** (Tennessee Valley Authority, Chattanooga (USA). Office of Power). [1988]. 58p. NTIS, PC A04/MF A01. Order Number DE88016105/JAW.

The following statements present the financial position at June 30, 1987, of the 160 locally owned and locally managed electric systems that distribute TVA power, together with the results of their operations for the fiscal year ended on that date. The statements are submitted to TVA annually by each municipal electric department and electric cooperative. All of the 110 municipal systems and 50 cooperatives reported to TVA that their financial statements for the year ended June 30, 1987, had been examined or reviewed by independent certified public accountants. TVA accountants review and assist the distributors with accounting practices or procedures but do not audit the accounts or reports.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 50899, 50932, 51393, 51394, 51411

51435 **(EFG—1987) Prince Edward Island Energy Corporation annual report, 1986-1987.** (Department of Energy and Forestry, Charlottetown, Prince Edward Island (Canada)). [1987]. 19p. (MICROLOG—88-02672). Island Information Service, PO Box 2000, Charlottetown, P.E.I., Canada C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objectives of the Energy Corporation are to develop and promote energy systems on an economic and efficient basis and to coordinate all government programs in the establishment and application of energy systems in the province. The Corporation operates within the general framework of provincial energy policy which is the responsibility of the Minister of Energy & Forestry. This report describes the Corporation's activities during the year and includes a summary of demonstation programs, research projects, and successful energy system applications. These have included the heating of provincially owned buildings with wood chip fuel, energy-from-waste plants, wind turbines, district heating systems, and various programs to promote the use of wood fuels. Financial statements are also included.

51436 **(EMR—88) Solar Energy Development Program.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1988. 10p. (In English and French). (MICROLOG—88-02855). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

Energy, Mines and Resources Canada recognizes the potential of renewable energy in our country's energy future. Its Solar Energy Development Program supports promising research, development and demonstration projects in active and passive solar energy, small hydro, wind energy, and photovoltaics. The program covers a range of activities, including resource assessment, materials research and development, development of computer modeling and design tools, improvements in system cost, performance and reliability, development of standards, funding of testing facilities, project demonstation and monitoring, market development, information activities, workshops, and technology transfer. This report outlines the activities of this program and provides basic information on applying for program funding.

51437 **(PB—88-214432/XAB) Simulation model for wind/diesel systems with energy storage.** Sundelin, J. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). May 1988. 63p. (In Swedish). (FOA-C—20712-2.7). NTIS, PC E04/MF A01.

A rather simple computer simulation model, written in SIMNON, was developed to study a proposed wind/diesel plant on the island Svenska Hogarna. The wind is calculated from a KAIMAL power-spectrum formula. From a number of 1-hour duration simulations, the number of diesel starts and fuel consumption for one year were calculated. Among the systems studied, wind turbine system with variable speed and no other power storage was assessed as a realistic alternative.

30 DIRECT ENERGY CONVERSION

51438 **(DOE/ER/13393—T1) Flexible automated optical sensing systems for the study and control of energy conversion processes: Final report, 15 July 1984--14 July 1987.** Kruger, C.H. (Stanford Univ., CA (USA). Dept. of Mechanical Engineering). 11 Aug 1988. Contract FG03-85ER13393. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015807/JAW.

Optical sensors integrated with computers are needed for the study and control of energy conversion processes. In this program systematic methods for combining the capabilities of optical sensors and computers to generate advanced optical sensing systems were studied. This research is interdisciplinary and involved investigation of sensors, optical signal analysis, computer integration, as well as the development of facilities for proof of the sensor systems. Of the several approaches and sensor types considered in the exploratory phase of this work, a number were brought to a fruitful position within a university research context where proof-of-concept experiments were performed and the results reported in the literature. In the continuing research, consolidation of the experimental activities was pursued with emphasis on plasmas as providing a rich environment for the investigation of sensor techniques.

3001 Mhd Generators

REFER ALSO TO CITATION(S) 50983

51439 **(DOE/ID/01745—T18) [MSE, Inc.] Quarterly technical progress report, April 1-June 30, 1988.** (MSE, Inc., Butte, MT (USA)). 1988. Contract AC07-78ID01745. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016254/JAW.

This quarterly technical progress report presents the tasks accomplished at the Component Development and Integration Facility during the third quarter of FY88. Areas of technical progress this quarter included: coal system development; seed system development; test bay modification; channel power dissipation and distribution system development; dry material transfer system controls upgrade; plasma velocity measurements; split coal feed system; coal-fired precombustor; continuing checkout of iron core magnet thermal protection system; combustion carbon balance and stack gas analysis; coal-fired combustor support; 1A channel refurbishment; arc observation project; test operations and results; data enhancement; technical papers; and projected activities.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 50983

3004 Thermionic Converters

REFER ALSO TO CITATION(S) 50983

51440 **(DOE/SF/15955—1) Thermionic Technology Program, fiscal year 1986: Final technical report.** Cone, V.P.; Dunlay, J.B. (Thermo Electron Corp., Waltham, MA (USA)). Dec 1987. Contract AC03-86SF15955. 89p. (TE—4400-227-87). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003944/JAW.

During FY 1986, the Thermionic Technology Program at Thermo Electron Corporation concentrated on advancing the development of cermet sheath insulators and additive converters. Both development efforts were based on the thermionic technology established by thermionic reactor programs during the 1960's and early 1970's. Improved sheath insulators and additive converters were fabricated during FY 1986 and delivered to Rasor Associates Incorporated, for extensive testing and evaluation. The most promising cermet fabrication process changed from dry ceramic powder coating of niobium spherical particles to the use of water-based slurries of ceramic powder and fine, irregularly shaped, niobium powder. Slurry processing is much more controlled and reproducible. The fabrication of crack-free, fully dense yttria alumina garnet (YAG) sheath insulator trilayers remains to be accomplished. Measurements of the thermal expansion of YAG indicate that the expansion mismatch with niobium (particularly from 1300 to 1500 C) may cause cracking. Limited evidence also suggests that high-temperature (1500 C and higher) reactions between YAG and niobium may also contribute to cracking. Alternative fabrication schedules need to be explored to minimize these adverse high-temperature effects. Preliminary tests indicate that alternative ceramics, such as oxide composites and aluminum oxynitride (ALON), show promise as improved sheath insulators. 41 figs., 5 tabs.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 50393, 50394, 50983, 50984, 51440, 51962

51441 **(CRIE-T—86052) Diagnostic technology on molton carbonate fuel cell.** Watanabe, Takao; Izaki, Yosiyuki. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1987. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770176/JAW.

In the development and evaluation of molton carbonate fuel cells, not only cell performance but also diagnosis of internal conditions of cells including their life and safety is important. This time, technology for quantitative diagnosis of basic cell functions even under general working condition has been developed. This technology is as follows: 1. Taking notice of the mass balance of atoms supplied to and discharged from the cell, a technique for obtaining dry-based exhaust gas compositions under general working condition was developed. Also, a technique for modifying the quantity of water contained in the exhaust gas was studied. 2. The internal temperature was estimated from the value of modification. The estimated temperature was almost equal to the actual operating temperature. 3. A program which evaluates gas leakage and short current rate using above techniques was developed. 4. An evaluation method using an easy drawing method available under standard working condition was also developed. (11 figs, 4 tabs)

51442 **(DOE/PC/79931—1) Oxygen electrode in molten carbonate fuel cells: First quarterly technical progress report.** Adanuvor, P.K.; White, R.E.; Appleby, A.J. (Texas A and M Univ., College Station (USA)). 31 Oct 1987. Contract FG22-87PC79931. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013715/JAW.

The oxygen cathode of the molten carbonate fuel cell is still not well understood because of the uncertain nature of the reaction mechanism. The objectives of this project include a study to examine the kinetics of oxygen reduction in molten carbonate fuel cells by unambiguous methods that allow the determination of the rate determining steps and the reaction parameters. The data from such kinetic studies require sophisticated analytical techniques for obtaining the kinetic mechanism that best fits the data and, consequently, the best estimates of the reaction parameters. 1. A program has been written to simulate the reaction sequences for oxygen reduction in a molten carbonate fuel cell at a rotating disk electrode. 2. The reaction sequence for the superoxide mechanism was simulated using assumed and literature values for the reaction parameters.

51443 **(ECN—87-169) Fault tree analysis for the benefit of the gas system for the 1 kW fuel cell.** IJpelaan, R. (Netherlands Energy Research Foundation, Petten). Dec 1987. 38p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A fault tree analysis is executed for the assessment of the reliability of the gas supply systems of the 1kW stacked fuel cell (molten carbonate cell). With the help of the computer model PHAMISS the fault tree is elaborated and the minimal cutsets of the tree are determined. The analysis shows that the gas supply systems are not designed optimally in all respects. Part of the system (in between humidifiers and fuel cell) was implemented insufficiently redundant. For the nitrogen backup system it was the other way round. This was taken into account while designing the gas systems. 3 app., 2 figs., 2 refs.

51444 (IZ—8601, pp 39-43) **Development of advance hydrocarbon-steam reformer for fuel cell by effective radiant energy converter.** Echigo, Ryozo; Yoshizawa, Yoshio; Yoshida, Hideo; Hanamura, Katsunori. (Tokyo Inst.of Tech., Faculty of Engineering, Tokyo, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji.

Out of the development studies made for reformers for fuel cells, the result of the study was mainly reported. Overall heat transmission coefficients between porous media separated by a solid wall were improved by as much as 10 to 100 times as compared with the conventional tubular type reformer. Temperature differences of operating gas on the heating and cooling sides were measured, changing thermal loads and using quartz glass and heat-resisting stainless steel as wall materials with a fixed thermal load. It was found that there were marked temperature decrease on the heating side, temperature increase on the heated side, and little influence of wall materials for the permiability of radiation. By this novel energy conversion technique, possibility was proved for the development of high thermal efficient reformers for fuell cells utilizing reform reaction of methane-steam mixture. The current advanced reformer would provide such features as low energy consumption, compact and simple construction, favorable dynamic responce, etc. (10 figs, 3 refs)

51445 **(JMF—8501) Report of technological survey on on-site fuel cells. Technological problems concerning fuel reforming apparatus.** (Japan Machinery Foundation, Tokyo). Jul 1985. 103p. (In Japanese). Japan Machinery Foundation, 3-5-8, Shibakoen, Minato-ku, Tokyo.

The cogenerative on-site fuel cell system which obtains power generation efficiency of 40% and can utilize heat equivalent to 40% in terms of input energy is deemed as one of the future energy system and its development is considered to be very important. In FY 1983, Industrial Machine association of Japan conducted a technological survey on on-site fuel cells on the basis of domestic technologies concerned, Also the conceptual design of cells in accordance with predetermined specifications was made, performance and cost of the cells were analyzed and the guidance for the future developments was established. In FY 1984 which is dealt with by this report, studies were made on clarification of characteristics, efficiency improvement, miniaturization and prolongation of durability which are required for the reforming apparatus for on-site fuel cells. The evaluation method by simulation analysis was also examined. For the reforming apparatus, a gasification reforming device was used. In this report, problems and countermeasures up to the time of commercialization on the above points are listed mainly from the viewpoint of the application of the reforming apparatus to this kind of cell. The detailed explanation on the evaluation method by simulation analysis is also attached seperately. (62 figs, 34 tabs, 3 refs)

51446 **(JMF—8502) Survey and research report on highly efficient energy utilization by application of energy saving technologies.** (Japan Machinery Foundation, Tokyo). Jul 1985. 204p. (In Japanese). Japan Machinery Foundation, 3-5-8, Shibakoen, Minato-ku, Tokyo.

To utilize the terminable energy as far effectively and highly efficiently as possible is the objectives of the Energy Efficient System-EES. This book is the report on the integrated survey and research conducted by Industrial Machinery Association of Japan on such already existing machines as gas engine (GE), diesel engine (DE), and gas turbine (GT) as well as such equipment now under development as fuel cell (FC) and Stirling engine (SE), which were selected as cogeneration systems fulfilling the above objectives, in terms of the respective EES specifications and economics, possibility of pupularization, and the future problems. From the viewpoints of EES, FC shows the highest energy saving effect, but the problem of high cost of cell itself needs its solution. SE is possible to make cogeneration using variety of energy. GT is appropriate for large scale facilities and DE for the facilities away from a commercial power supply system. GE is at present inferior costwise to purchased power. (122 figs, 90 tabs, 37 refs)

51447 **(JMF—8602) Technical survey on the fuel cell. Medium and small type, internally modified molten carbonate type.** (Japan Machinery Foundation, Tokyo). Jul 1986. 125p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88770170/JAW.

This is a study by the Japan Machinery Federation as a theme in 1985 for the comprehensive energy development. Development status and problems are made clear by describing on such required performance as efficiency and life, cell technology on electrode, electrolyte plate, laminating technology, system technology as heat generation and cooling, power generation system, heat utilization, operation method, and internal modification by means of catalysts, Simulation was carried out for two system models of internally modified type (steam separation type, anode gas recycling type) and externally modified type (external burning type, sensible heat heating type). As a result, the power generation efficiency was maximum in the case of steam separation type which has the present efficiency of 50.75 % and the future possibility of 54.64 %. (62 figs, 32 tabs, 52 refs)

51448 **Solid oxide fuel cell technology.** Brown, J.T. (Westinghouse Electric Corp., R and D Center, Pittsburgh, PA (US)). *IEEE Transactions on Energy Conversion;* **3**: No. 2, 193-198(Jun 1988).

High temperature solid oxide fuel cell (SOFC) systems show great promise for economical production of electricity and heat in a variety of commercial, industrial cogeneration, and electric utility systems applications. Pioneered by Westinghouse in the 1960's, this technology is based upon the ability of stabilized zirconia to operate as a solid electrolyte at elevated temperatures. It is illustrated that the cells readily conduct oxygen ions from an air electrode (cathode) where they are formed, through the zirconia based electrolyte to a fuel electrode (anode), where they react with fuel gas CO or H/sub 2/ or any mixture, e.g., steam reformed natural gas, and deliver electrons to an external circuit to produce electricity. These fuel cells operate at temperatures near 1000°C and are the basic building blocks for highly efficient combined heat and electric power, or all electric power generators.

3008 Miscellaneous Converters

51449 **Thermoacoustic engines.** Swift, G.W. (Condensed Matter and Thermal Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Acoustical Society of America;* **84**: No. 4, 1145-1180(Oct 1988).

Thermoacoustic engines, or acoustic heat engines, are energy-conversion devices that achieve simplicity and concomitant reliability by use of acoustic technology. Their efficiency can be a substantial fraction of Carnot's efficiency. In thermoacoustic prime movers, heat flow from a high-temperature source to a low-temperature sink generates acoustic power (which may be converted to electric power using a transducer). In thermoacoustic heat pumps and refrigerators, acoustic power is used to pump heat from a low-temperature source to a high-temperature sink. This review teaches the fundamentals of thermoacoustic engines, by analysis, intuition, and example.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 50632, 51405, 51446

51450 **(IZ—8601) FY 1985 Annual Report of The Iwatani Naoji Foundation.** (Iwatani Naoji Kinen Zaidan, Tokyo (Japan)). 20 Aug 1986. Vp. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

Individual papers in scope for the data base are processed separately. (DLC)

51451 **(STU-I—593-1986) Effective application of electricity. Proposal for a research and development program.** (Swedish National Board for Technical Development, Stockholm). Dec 1986. 44p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754463/JAW.

The report describes a program proposal for the National Swedish Board for Technical Development 1987-1990. For the period a budget of 40 MSEK is proposed allocated to Basic Technics (8) Motor Operation (8), Electrothermal Techniques (8), Technical Electrochemistry (6), Illumination-Transmission-Various Appliances (7) and System Engineering (3).

3201 Buildings

REFER ALSO TO CITATION(S) 50927, 51338, 51340, 51386, 51534, 51551, 51914, 52081, 52082, 52108

51452 **(AE/ECB—88) Wood heating.** (Alberta Energy, Edmonton (Canada). Energy Conservation Branch). 1988. 31p. (MICROLOG—88-03047). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This booklet is intended to help homeowners interested in wood fireplaces or stoves. It contains information about the basic types of wood and coal stoves and fireplaces, their components and possible accessories, and how to size them according to requirements. Guidelines are given on the installation of such appliances, with emphasis on those points that contribute to safe and efficient

operation. Operation and routine maintenance procedures are suggested, including proper chimney cleaning and wood fuel preparation. 15 figs., 2 tabs.

51453 **(AE/ECB—ENR1-17NO3) Basement insulation.** (Alberta Energy, Edmonton (Canada). Energy Conservation Branch). 1988. 21p. (MICROLOG—88-02848). Alberta. Dept. of Energy, Petroleum Plaza Twr., 9915-108 St., Edmonton, Alta., Canada T5K 2C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This booklet recommends basement insulation as a means of conserving heating energy in homes in Alberta. It covers the basics of insulating basement walls from either the inside or the outside, and insulating basement floors. Inside versus outside insulation advantages are compared. For interior insulating, two methods are to use wall framing filled with glass fiber batts, or fastening rigid board insulation to the wall. Vapor barriers and sealing are also discussed. For exterior insulating, the partial depth method involves placing insulation down to 12 in below ground, then 3-4 ft horizontally from the wall at that depth to control lower wall heat loss. The full depth method requires placing the insulation vertically down the entire wall to the footings. Tools, wall preparation, and materials are explained. Finally, floor insulation is briefly covered, primarily as a means of increasing comfort. 16 figs.

51454 **(AE/ECB—ENR1-17NO5) Heating system maintenance.** (Alberta Energy, Edmonton (Canada). Energy Conservation Branch). 1987. 16p. (MICROLOG—88-03306). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C WITHIN PROVINCE CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three quarters of energy used in the home is for heating. Maintaining the water and space heating systems helps to ensure this energy is used in the most efficient way. This booklet is intended to help homeowners do this. The first part discusses the safety aspects of heating systems, and maintenance to ensure proper venting of heating appliances. Simple suggestions are given for hot water heater maintenance and applying thermal insulation is suggested as an energy conservation measure. Finally, the basics of maintaining the types of space heating systems commonly found in Alberta are presented. Most of this section deals with forced-air systems, and covers such procedures as cleaning ducts and filters, lubricating and adjusting blowers, and optimizing furnace cycling. Servicing of hot water systems includes air bleeding, pump lubrication, maintaining water levels, and inhibiting corrosion. Thermostat setback is briefly discussed. 12 figs.

51455 **(AE/ECB—ENR1-17NO9) Condensation concerns.** (Alberta Energy, Edmonton (Canada). Energy Conservation Branch). 1986. 24p. (MICROLOG—88-03307). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C WITHIN PROVINCE CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This booklet is intended to help homeowners in Alberta to understand what condensation signifies, both in theoretical and practical terms. Surface condensation, which forms on cold surfaces in the home when the outdoor temperature is sufficiently low, and concealed condensation, which can occur when water vapor goes through cracks and holes, are explained, with reference to the ambient conditions prevalent in Alberta. In order to help the identification, evaluation, and solution of condensation problems, a summary is presented of the common areas where condensation and moisture buildup occur, along with possible causes and suggested solutions. Such solutions include simple housekeeping measures, increasing outside air intake, and incorporating air-to-air heat exchangers to recover heat from resultant exhausted air. 7 figs., 5 tabs.

51456 **(AE/ECB—ENR1-17NO13) Ventilating your home.** (Alberta Energy, Edmonton (Canada). Energy Conservation Branch). 1988. 20p. (MICROLOG—88-02841). Alberta dept. of Energy, Petroleum Plaza Twr., 9915-108 St., Edmonton, Alta., Canada T5K 2C9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This booklet is intended to help the homeowner identify and remedy possible problems with air quality and ventilation. Recent efforts to conserve energy have led many homeowners to reduce air leakage by installing vapor barriers, sealing and weatherstripping, or other techniques. This has led, in many cases to humidity and indoor air pollution problems, which are identified and explained. Solutions for controlling indoor air quality include proper selection of building materials, proper venting and operation of appliances such as furnaces and stoves, and reduced use of pollution-causing products. Another problem of concern to health is backdrafting of combustion gases, occurring when combustion air in furnaces is not being properly replaced. A number of ways are outlined to identify and solve this problem. Selection of ventilation systems is discussed, with reference to Alberta building codes. Overall design and system characteristics are given for passive, exhaust-only, and heat recovery ventilation systems, and guidelines are presented for selecting and installing heat recovery ventilators. 10 figs., 1 tab.

51457 **(AE/ECB—ENR117-NO12) Windows.** (Alberta Energy, Edmonton (Canada). Energy Conservation Branch). 1986. 31p. (MICROLOG—88-03305). Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, Alta., Canada T2P 3G4; $N/C WITHIN PROVINCE CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Poor window performance in houses can increase space heating costs, cause overheating, poor ventilation and other problems. This booklet is intended to aid the homeowner to understand windows and how to make them work properly. Basic window terminology and window styles are presented. Heat infiltration through windows by conduction, convection and radiation is explained, along with air leakage. A guide to assessing window performance, identifying problems, and identifying causes and solutions to these problems is presented. Procedures for solving many of these problems are given; such procedures include repair, caulking and weatherstripping, adding storm windows, upgrading of glazing, solar radiation control, and replacement of existing windows. 9 figs., 3 tabs.

51458 **(AEC—AECL-8110) Oil/electric hybrid heating experiment and demonstration.** Elliott, R.K. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1983. 235p. (CE—01813). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Oil/electric heating systems and energy measuring instrumentation were installed in 50 houses in Deep River, Ontario. These were operated and monitored for two heating seasons to demonstrate their performance and determine the percentage oil placement as a function of heater capacity and control system. All experimental data was stored and processed by computer. It was found that oil furnace utilization efficiency varied from 48 to 59% for an average of 53.5%. Oil displacement ranged from 49 to 83% for 2.5 and 5.0 kW electric heaters controlled by two-stage indoor thermostats. Fuel costs for oil/electric hybrid heating, with 5.0 kW plenum heaters and indoor two-stage thermostats, were 20% less than for oil heating, based on average furnace efficency and 1983 January retail fuel prices. Annual load factors above 37% were achieved for plenum heaters compared to 11.9% for all-electric systems. Space heating requirements were proportional to heating degree days calculated with a balance temperature of 14/sup 0/C rather than standard 18/sup 0/C. Conventional heat loss calculating methods yield results which are at least 80% higher than experimental results. This report also describes background information, the heating equipment and instrumentation, data processing, dis-

semination of information about the system, other multi-source heating and cooling systems and the use of interruptible power to promote widespread application of hybrid heating. 48 figs., 19 tabs.

51459 (ASHRAE/SP—49, pp 1146-1149) **BTESM national program: past, present, and future.** Lundy, T.S. (Oak Ridge National Lab., TN (USA)). 1986. NTIS, PC A99/MF A01. Order Number DE88012471/JAW. (CONF-851202—).

From DOE-ORNL-ASHRAE-BTECC conference on thermal performance of the exterior envelopes of buildings-III; Clearwater Beach, FL, USA (2 Dec 1985).

This paper reviews some of the history of the National Program for Building Thermal Envelope Systems and Materials (BTESM) indicating key decisions for important components of the program including such things as creation of the Building Thermal Envelope Coordinating Council (BTECC) and implementation of this series of conferences involving ASHRAE (and now BTECC) as joint sponsors with DOE. Meaningful technical research results and information dissemination to targeted audiences within the total building community are important components of the program operation. This paper also describes both the formalized technology transfer activities, including the holding of institutes for architectural and engineering faculty members and student design competitions, and one of several informal person-to-person networks of technical information sharing within the total building community.

51460 (AV/CE—35) **A study of residential housing envelope heat losses.** Ackermann, M.Y. (Alberta Univ., Edmonton (Canada). Dept. of Chemical Engineering). Apr 1983. 42p. (CE—01810). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An attempt was made to evaluate the methods proposed by the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) with regard to their suitability for the prediction of seasonal energy requirements in residential structures. It was found that the steady state method proposed was acceptable for the prediction of losses for the majority of the above grade components tested as long as the structure was built to utilize passive solar gains. The study allowed the determination of several areas in which the methods proposed were extremely difficult to use or were highly dependent on material properties which are not well known or may vary under situ conditions. The first problem area identified was the estimation of infiltration rates under in situ conditions using test models in Alberta. Infiltration rates determined using sulphur hexafluoride gas concentration decay methods were found to be 0.25 to 0.75 air changes per hour under typical winter conditions. Leakage rates predicted using ASHRAE methods, based on the based on the number of breaches in the building envelope, were in the range of 0.5 to 1.5 changes per hour. The area in which most discrepencies occurred were those structures below grade. The magnitude of the deviation from predicted values was found to increase with the depth below grade. It was felt that the primary reasons for the differences between measurements and predictions were due to variations in soil moisture content from the assumed values and the time lag of ground temperature variations with respect to the ambient seasonal variation. 12 refs., 40 figs., 17 tabs.

51461 (BFR-R—1-1988) **Laboratory testing of heat pumps. Experiences from 1984-1986.** Fahlen, P. (Statens Provningsanstalt, Boraes (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 89p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754376/JAW.

This report present experiences from laboratory testing of heat pumps at the Swedish National Testing Institute during the period 1984-1986. A total of 186 heat pumps have so far been tested at the institute, 71 of which were tested during the investigated period. Comparisons between results obtained during different years show that performance data improved significantly up to 1983, thereafter improvements have been marginal. Tested values for coefficients of performance and heat output are on average 10-12% below data by manufacturers. Remarkably large deviations are shown to exist between different makes of heat pumps, both concerning coefficient of performance, heating of sanitary hot water, defrosting efficiency and noise levels. As an example the difference between the best and the worst tested results with the same operating conditions was 42% for the coefficient of performance of liquid/water heat pumps. Even larger deviations exist concerning the efficiency of sanitary hot water heating. For summer operating conditions the best heat pumps are 150% better than the worst and for winter conditions 160%. Additional results describing how various parameters such as flowrate, temperature, humidity etc. affect the operation of heat pumps are presented in a large number of diagrams. Results are mainly given in the form of barographs showing the scatter of test results for the various sensitivity factors.

51462 (BFR-R—6-1987) **Stockholm project. Increased insulation and quality control, the town block Sjukskoeterskan.** Nilsson, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 122p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88754377/JAW.

This project is a subproject within the Stockholm project. Its objective is to: -test and develop methods of insulating walls and floors to a standard higher than that specified in current codes, -test and develop methods for quality control right through the construction process, from the sketch design stage to maintenance and administration. The project has produced data for design and construction documents. The building was finished and the occupants moved in over a year ago. Apart from the technical descriptions and an account of the quality control applied, the report also contains energy balance calculations, cost analyses and details of the experiences gained during design and construction. The project is being evaluated by the Royal Institute of Technology and Stockholm City over the period 1985-87.

51463 (BFR-R—45-1987) **Maersta Nursing Home energy conservation project.** Andersson, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 217p. (In Swedish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754385/JAW.

Maersta Nursing Home consists of an H-shaped ward building with 4x12 beds and a supply building. The design of the ward sections, with four blocks of equal size but incorporating different building methods and different installation services, has permitted comparative investigations of performance, energy savings, operating costs etc. The project has included everything from initial design and construction to performance measurement and assessment. Data from parameters affecting energy consumption has been continuously monitored over a period of more than three years. About ten million hourly mean values have been logged for the production and analysis of energy balances for individual components and for parts of the buildings. The report compares the performance of massive and light building structures with different insulation levels, different types of window design, airborne and waterborne heating systems regenerative and recuperative heat exchangers and other variables. Different types of water-saving taps are compared, as are economy-flush and normal-flush lavatories. The value of waste water heat exchangers, solar collectors for domestic hot water production, recovery of heat from refrigerator condensers, conversion of flushing desinfectors and so on are also considered. The objective has been achieved, and the results indicate that 50% savings can be obtained without any reduction in the standard of either thermal comfort or hygiene. In general, it can be said that well-planned energy conservation measures make it easier to establish a good indoor climate. The report also reveals that an energy-efficient building can be produced without incurring higher building costs. (authors).

51464 (BFR-R—67-1986) **Apartment houses with controlled natural ventilation and heat recovery plant.** Eriksson, L.; Masimov, T.; Westblom, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 87p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754387/JAW.

This report deals with the development of a new system for ventilation, particularly suitable for installation in existing apartment houses with natural ventilation. The main components in the system are automatically temperature controlled devices for intake air and a specially shaped cap on top of the chimney. An additional

advantage with the system is that it is relatively simple to be equipped with heat pump for recovery of heat from the exhaust air where so is possible. (G.B.).

51465 **(BFR-R—103-1986) Energy conservation block in Malmoe. Energy management in residential buildings.** Hansen, E.; Lindstroem, B.; Norlin, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 79p. (In Swedish). NTIS (US Sales Only), PC A05. Order Number DE88754389/JAW.

The purpose of the project is to achieve a considerable reduction of energy costs for heating and hot water production. A calculated reduction of 30% was not achieved, the best result was 20%, mainly because the tenants would not accept an indoor temperature lower than 23 degrees C. (G.B.).

51466 **(BFR-R—108-1986) Backlund system solar and ground source heat installation in a housing area at Sveg. Measurement and evaluation.** Holmlund, I.; Nilsson, G. (I. Holmlund AB, Oestersund (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1986. 55p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88754391/JAW.

Project goals: -determination of the coefficient of performance of a separate ground source heat pump and of a ground source heat pump incorporated in a system with i.a. running time as a parameter. -mapping of the energy balance of a ground source heat pump. -investigation of the performance of a so-called climate cage. -investigation of the temperature course in the heat storage. The investigations were made during the winter 1982-1983 which was warmer than normal and during the normal winter 1983-1984. The results are summarized as follows: -The coefficient of performance of a separate ground source heat pump amounts to between 2.5 to 1.9. The yearly mean value is 2.21 which is normal for the prevailing temperature situation. -The coefficient of performance of a heat pump (U3 and U6) incorporated in a system amounts to between 1.85 to 1.2. The reason for the low system coefficient is that all the heat pumps are connected to one system and are operating simultaneously. This results in the pumps operating at a low load and with short operation periods. Due to this the operation conditions for the heat pumps are unfavourable resulting in a lower coefficient of performance. -The functioning of the climate cage is made clear. The energy requirement for heat transmission is decreased by c. 5%. The energy demand for heating ventilating air is desreased by c. 20%. Calculations show that the influence of the climate cage implies a decrease of installed maximum power by c. 1kW per apartment. -The swamp is an excellent heat source where the charging and discharging periods succeed each other without affecting respective function.

51467 **(CCA—7879) The potential for energy conservation in the residential sector.** Cullen, C.W. (Consumer and Corporate Affairs Canada, Ottawa, Ontario). Apr 1979. 142p. (CE—01880). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The main goal of this paper is to lay the foundation for an exhaustive analysis of the potential for energy conservation in the residential sector in Canada. In many respects this paper serves as a state-of-the-art review of residential conservation techniques. Residential energy consumption may be categorized into space heating, transportation, water heating, appliances and lighting. Energy can be saved in each of these sectors through technological improvements or behavioral changes. Determining potential energy savings involves investigating each of the sectors from both a technological and behavioral focus. This paper is organized in accordance with this simplified approach. The appendices list energy consumption data and give an analysis of potential savings for each end-use sector listed above. Several of these tables of data include information on consumer attitudes toward various conservation techniques. Some of the observations noted in this paper are as follows. Energy savings of 30% of current consumption are potentially achievable, and this can be done through either a product focus or a consumer focus. The largest potential area for saving lies in space heating and private automobile use, with water heating also very large in absolute terms. In general, predictions of potential energy savings appear to be slightly higher for technical modifications than for beavioral changes, although less is known about the role of consumer behavior in determining potential energy savings. 171 refs., 2 figs., 26 tabs.

51468 (CGA—8710, pp 15) **Growing smarter with controls.** White, W.G. (Honeywell Ltd.). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

This presentation addresses the environmental segment of controls related to the gas industry. Recent developments in control technology has changed both the application and equipment itself in the consumption of energy. Such changes have tended to be towards replacing mechanical or electromechanical devices with microelectronic, digital devices. These have introduced the possibility of new functions not possible with older kinds of controls, such as communications and self-diagnostic capabilities. Specific kinds of controls are discussed. For gas burners, the new generation of controls will incorporate all traditional control functions, including ignition and flame supervision, into one logic module with appropriate sensors, and will enable remote monitoring. For commercial make-up air units, new controls can save energy by evaluating various parameters and adjusting heating, cooling, or ventilation accordingly. For household use, the programmable thermostat is a known innovation; future developments are likely to include controls that not only deal with temperature but also such things as appliance monitoring.

51469 (CGA—8710, pp 9) **What's happening in fireplaces.** Koby, V. (Hunter Enterprises Orillia Ltd.). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

This presentation describes the concept of the gas fireplace as a means for promoting greater use of gas in Canada. The fireplace is of the type that simulates a wood burning fireplace without the inconvenience of wood handling and other disadvantages, but with the provision for providing heat by radiation and/or convection via blowers. The Canadian market for such devices is estimated by extrapolating from the British Columbia market, which is estimated to use ca 21,000 cubic feet per gas fireplace per year. The marketing program in British Columbia is outlined, involving advertising, financing support, sales promotion, and public relations. This has resulted in sales of 17,000 units in around a year and a half.

51470 (CGA—8710, pp 42) **Better home comfort saving energy and money with better home design.** Dale, J.D. (Univ. of Alberta). 1987. (In French). (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

Field experiments are described which were conducted at a test facility in Alberta having six electrically heated houses with various levels of insulation and other energy conserving measures. It was found that increased insulation levels decreased the heating energy requirements, although the savings from one level to the next were not as large as one might expect. Basement heat losses can be 30-40% of total losses, for uninsulated basements, and air infiltration accounts for 20-35% of total losses in uninhabited houses. Furnace flues were found to be the dominant factor in air leakage. Careful, expensive air/vapor barrier installation methods did not significantly improve airtightness compared with more conventional methods. To utilize passive solar gains properly, well-sealing insulating shutters are necessary. Good agreement was obtained between field and laboratory seasonal efficiency ratings of natural gas furnaces. To present the energy conservation results in a more meaningful manner, the results on potential energy savings were scaled to typical full-size houses. Four designs were compared, ranging from one with minimal levels of insulation and other features to a superinsulated house with tight construction, heat recovery ventilation, multiple glazed windows, and a high efficiency furnace. Two locations were used, Edmonton and Toronto. Economic analysis showed that for current costs of construction, equipment and energy, the more advanced designs are not necessarily a good investiment, the payback period being more than 8 years. A com-

promise is recommended to trade off increased construction costs against money saved through reduced energy consumption. 17 figs., 7 tabs.

51471 (CGA—8710, pp 39) **C.G.A. appliance merchandising study.** Barton, J.M. (Consumers Gas). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

This presentation contains an outline for a gas appliance strategy study in Canada, arising from the industry's declining performance in gas appliance sales and gas consumption. Data are presented in graphic form on such factors as penetration of gas appliances in households, consumer attitudes, and appliance sales in various product categories. Barriers to acceptance of gas appliances are discussed; these include product design and quality, performance, manufacturing techniques, regulatory restrictions, problems with installation and service, ease of purchase, and perceptions of operating costs. A number of strategies are proposed to improve the gas appliance business. These include individual product strategies appropriate for specific kinds of appliances, improved installation and servicing, reduction of regulatory barriers, and better advertising and promotion. Costs for this overall program are felt to be modest compared to the potential benefits, and are estimated to run around $7.5 million annually after the initial two startup years. 14 figs.

51472 (CMHC—1807) **Modelling of residential air change heat loss in the CMHC-2 program.** Swinton, M.C.; Webster, D.W.; Tremayne, M.A. (Canada Mortgage and Housing Corp., Ottawa, Ontario). Jul 1983. 44p. (CE—01781). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The Canada Mortgage and Housing Corporation-2 (CMHC-2) residential energy analysis and cost-optimization model ranks energy conservation options for individual house components on the basis of cost-benefit merit of each option. A means of relating cost to benefit has been developed for conservation measures involving the airtightness of components. The resulting air change model, developed jointly by CMHC and Scanada Consultants Limited, was presented in this report. The model was intended to assist in the design and choice of air barrier systems for new construction by evaluating design options on a cost/benefit basis. The focus of this report was the algorithm developed for estimating air leakage through cracks and unintentional openings, since this phenomenon is a strong function of construction technique and quality of workmanship. The method consisted of relating cracks and openings associated with all of the major house components, and their design detail and construction quality. A sensitivity analysis was undertaken using the model to illustrate its use and to assess its credibility in a preliminary fashion. The study concludes that the presented method can be used with a measure of confidence for evaluating air tightening options in new construction and air leakage performance for existing structures, since it was derived to fit field test data, using conventional engineering judgement. 6 refs., 14 figs., 8 tabs.

51473 (CONF-880814—3) **Energy savings due to model conservation standards in multifamily buildings.** Tonn, B.E.; White, D.L.; Currier, C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88014564/JAW.

From Summer study on energy efficiency in buildings; Pacific Grove, CA, USA (28 Aug 1988).

In the past several years, the Bonneville Power Administration and utilities in the US Pacific Northwest have invested significant amounts of money in retrofitting existing dwellings with energy conservation measures. In 1983, regionwide Model Conservation Standards (MCS) were developed to guide the construction of energy efficient dwellings in order to preclude the more expensive retrofitting process. This paper evaluates energy savings attributable to MCS in the unfamiliarity sector. The sample of buildings used in this study is located in Tacoma, Washington. Forty-seven buildings, with a total of 602 units, comprise the MCS or study samples. Thirty buildings, with a total of 158 units, built before 1984 under current practice energy and building codes, comprise the control sample. Billing histories were collected for each unit in all buildings for the period of January 1985 to December 1987. Data on unit size and spatial orientation were drawn from building plans and on-site inspections. Occupants of the buildings were surveyed about energy use, demographic characteristics, and characteristics about their apartment units (e.g., rent, location). This paper presents the differences in electricity use between the MCS and non-MCS samples and estimates differences in multifamily household electricity use (with a focus on space heating) according to significant demographic and unit descriptors. It is estimated that between 0.8 kWh/ft²/year and 1.8 kWh/ft²/year of space heating electricity savings are attributable to the MCS for multifamily buildings. 13 refs., 9 tabs.

51474 (CONF-880814—7) **Energy measurements of attic radiant barriers installed in single-family houses.** Levins, W.P.; Karnitz, M.A. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015303/JAW.

From Summer study on energy efficiency in buildings; Pacific Grove, CA, USA (28 Aug 1988).

Testing was conducted by the Oak Ridge National Laboratory to determine the energy savings attributable to radiant barriers installed in attics of unoccupied single-family houses. Three levels of fiberglass attic insulation (R-11 ,R-19, and R-30) were tested with two types of barrier installation (horizontal and truss). The results showed that horizontally installed radiant barriers were more effective than truss barriers in reducing heating and cooling loads. Measured cooling load reductions ranged form 0 to 22% (compared to same attic insulation insulation R-value with no radiant barrier) and heating load changes from {plus}4% to {minus}10% were measured (compared to same attic insulation R-value with no radiant barrier). Radiant barriers appeared to decrease the heating and cooling loads more when lesser amounts of insulation (R-11 and R-19) were present in an attic. Minimal changes were measured when R-30 was present in an attic. Long-term effects of dust on the performance of radiant barriers as well as the effects of moisture condensing on the surface of a radiant barrier during cold winter temperatures remain unanswered.

51475 (DOE/MA—0328) **Utilities planning and management for Department of Energy facilities.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Project and Facilities Management). Aug 1988. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88016821/JAW.

This Manual has been developed for DOE facility managers and site planners to assist them in the planning, acquisition, and management of utility services. It identifies critical issues and provides suggested methods and procedures to implement DOE Order 4300.1B, Real Property and Site Development Planning, and DOE Order 4540.1B, Acquisition and Management of Utility Services. It should be emphasized that this Manual is not intended to place additional burdens on field personnel, but rather to assist in the planning, acquisition and management of utility services. Not every section of this Manual will be applicable to every site, and field personnel should not infer that they are required to perform every action described. Where the Federal Acquisition Regulation (FAR), DOE Acquisition Regulation (DEAR), or DOE Orders impose a requirement, the source of the requirement is referenced in the Manual, along with a discussion of how the requirement can be met, but the Manual does not establish additional requirements. Detailed discussions of technical issues related to the physical or mechanical aspects of utility service are not provided. However, several economics-related technical appendices have been prepared that address forecasting, utility rates and ratemaking, life-cycle cost calculations and risk assessment. The focus of the Manual is on electricity and natural gas.

51476 (EI—121981) **Light energy conservation from labelling switches, a study. Phase 1. First interim report.** (Engineering Interface Ltd., Willowdale, Ontario (Canada)). Dec 1981. 22p. (CE—01690). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The greatest potential for lighting energy savings in the commercial sector is in existing buildings. One of the most common lighting controls already in buildings is the simple wall switch. Studies have shown that the wall switch is not used effectively. That is, lights are left on when spaces are unoccupied and when sufficient daylight is available. If the wall switch were used properly, conservative estimates of lighting energy savings of the order of 20% can be projected. Sticker or labelling campaigns have been used to encourage energy conservation. This document presents a proposal for a study to make a preliminary identification of and justification for the scope of the effects of light switch stickers on human behavior, list the factors that could affect light switching behavior of occupants, identify methods of analysis and equipment that could be used in data collection, and assemble the identified factors into an experimental design. The study would concentrate on offices because it is believed that larger potential savings are available compared to schools. Evidence to date suggests that the school classroom switch is already used quite effectively. 5 refs., 5 figs., 5 tabs.

51477 **(EJF—82-127) Urban recreation retrofit.** (Faraci (E.J.) and Associates Ltd., Winnipeg, Manitoba (Canada)). Apr 1985. 66p. (CE—01874). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

Four recreation facilities in Manitoba were analyzed for possible energy conservation techniques. These facilities were then retrofitted based on a consultant's recommendations provided in the facility energy reports. It is intended that the summary data presented in this report be used to form a guide for future energy conservation effort in recreational facilities in Manitoba. For each facility, the energy and cost savings and the retrofit implementation cost were estimated, allowing a projected simple payback period to be determined. For all four facilities, the combined projected retrofit cost was $412,000 and expected annual savings were estimated at $124,000, yielding a projected simple payback period of 3.3 years. The retrofits are expected to give overall energy and cost savings of 21% and 24% respectively. Many of the cost effective energy conservation techniques were common to each facility studied. For instance, most facilities with daily unoccupied periods can employy the following techniques: reduce space temperatures at night, cover pool surfaces to prevent evaporation, shut off ventilation equipment, and decrease outside air ventilation volumes. Other cost effective techniques include: use off-peak electrical power for heating, ensure the correct power factor, improve combustion efficiency, delamp excessively lit areas, use heat recovery systems on ice compressors and on supply and exhaust air stream, consider pool humidifiers, and employ low flow shower heads. 12 figs, 8 tabs.

51478 **(EJFA—83-171) Enerhosp final report.** (Faraci (E.J.) and Associates Ltd., Winnipeg, Manitoba (Canada)). Mar 1985. 75p. (CE—01876). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A program was initiated providing technical and financial assistance for testing and demonstrating various energy conservation measures in a total of eight Manitoba health care facilities. Assessing the facilities was accomplished through a facility index survey. Manitoba health care facilities were categorized and assessed according to their energy usage characteristics. Energy cost, energy consumption, and unit energy price indices were determined for each facility in each category. This procedure provided a means of selecting eight health care facilities which were good candidates for energy conservation but which were also well distributed across the province. Energy conservation measures were brought through to their implementation. Some of the retrofit techniques involved changes to maintenance and operating procedures, structural, mechanical, and electrical systems, as well as the building envelope. It was recommended that all areas of energy conservation studied during this program should be considered by other health care facilities. The only notable exception is the upgrading of wall and roof insulation, which, in general, showed long, uneconomical payback periods. The total program was highly successful with an overall payback of 3.9 years. 9 figs., 18 tabs.

51479 **(EMR—88) Current developments in high-performance window technology.** Mayo, T. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1988. 5p. (CE—01849; CONF-8804188—). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From 2. annual conference of the Association of Energy Management Analysts; Toronto, Canada (11 Apr 1988).

This paper presents developments in windows that relate to their thermal performance, and is presented as an outline only. Topics included are: components, R values and energy savings according to the type of glazing, types of solar coatings, gas-filled sealed units, frames and spacers, and current research.

51480 **(EMR—M92-23/1987E) Residential wood heating. A homeowner's guide.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1987. 36p. (MICROLOG—88-02854). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

For many people, heating with wood will reduce bills for expensive fuel oil, electricity, propane or natural gas. This book describes the types of wood-heating equipment available and how to install and operate a wood-heating system safely. Installing wood-heating equipment is expensive. Effective and economical use of wood heat requires a reliable supply of wood at reasonable prices, and extra time and effort for operation and maintenance. A wood-heating system has three basic components - the appliance, the venting system and the fuel supply. Appliances come in a variety of types, shapes and sizes. For maximum heating efficiency, the appliance should be designed in such a manner that controlled combustion can be achieved. The various options and selection criteria are discussed. Design of the venting system which pulls combustion air in over the wood and exhausts the waste products outside the house is just as important as design of the heater. Chimneys must be installed properly and cleaned regularly to ensure long-term reliability. The efficiency of a wood-heating system is affected by the quality of the fuel. In addition to having a reliable source of wood, adequate covered storage space for winter supply is necessary. However, with a little care and planning, heating with wood can be enjoyable, economical and safe. 38 figs., 2 tabs.

51481 **(EMR—M92-23/1987F) Residential wood heating. A homeowner's guide.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1987. 39p. (In French). (MICROLOG—88-02854). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

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51482 (ENR/SE—1988) Some methods of saving energy with fluorescent lighting. (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). 1988. 8p. (MICROLOG—88-02852). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The positive features of fluorescent lighting have continued to foster research and development work aimed at improving the energy efficient properties of fluorescent lamps and expanding their uses. Two research projects with these goals in mind are described in this report. One project is related to electronic ballasts, which are more energy efficient than magnetic ballasts. They are expensive, and their operating characteristics are not necessarily well matched to the voltage demands of fluorescent lamps. Consequently a program was initiated to design a better energy-saving electronic ballast suitable for fluorescent lamps. Concepts such as unipolar and bi-polar lamp excitation, a transformer drive circuit, and use of a bridge were proposed and analysed. The transformer drive system was regarded as the most suitable. It is essentially a solid state version of the conventional line frequency ballast, but much smaller. The other project assessed several potential applications for new mini-fluorescent lamps, as well as their performance, in field installations. It was concluded that compact fluorescent lamps are a cost-effective substitute for continuously operated incandenscent lamps, but in some downlighting situations, lumen output may be insufficient to satisfy building code requirements. Particularly when used in exit signs, the chief advantages of mini-fluorescent lamps are: elimination of heat damage to enclosure, reduction of the amount of wiring and power system electrical load and emergency, and provision of as much light, but at a lower wattage than incandescent lamps, with a substantially longer life. 3 figs., 1 tab.

51483 (EPRI-EM—5968) Air infiltration and interzonal airflow measurements in research houses: Final report. Nagda, N.L. (Electric Power Research Inst., Palo Alto, CA (USA); GEOMET Technologies, Inc., Germantown, MD (USA)). Aug 1988. 109p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015353/JAW.

Four different but complementary methods--the tracer gas dilution method, single tracer constant concentration, passive perfluorocarbon tracers (constant release), and constant release of multiple halocarbon tracers with real-time analysis--were used to obtain detailed information on air infiltration and interzonal airflow rates in two bilevel research houses. The study included measurements of seasonal variations and differences between the houses, one of which was retrofitted in a previous EPRI study to reduce the air leakage area. Measurements showed that there had been little change in whole house infiltration rates during the 4 years since the retrofit. Differences between the houses with respect to whole house air infiltration rates were primarily the result of differences in downstairs air infiltration rates between the two houses. Zone-specific measurements indicated that downstairs infiltration rates were three to nine times higher than upstairs; infiltration rates were 30 to 60 percent lower in the downstairs of the retrofitted house than in the other house. The impact of the retrofit was also reflected by lower rates of airflow from the garage into the downstairs and from the upstairs to the attic. Airflows between the upstairs and downstairs of the houses exhibited seasonal variation due to stack effect action and operation of the central heating and cooling systems. Short-term interzonal airflow rates were as much as an order of magnitude higher than week-long average rates. Results of measurements with the different methods are also compared and discussed as they relate to advantages, limitations, and applicability of the methods in utility-sponsored measurement programs. 30 refs., 22 figs., 16 tabs.

51484 (EPRI-EM—5994) Effects of occupancy on residential indoor air quality, infiltration and energy use: Final report. Nagda, N.L.; Koontz, M.D.; Trehan, A.K. (Electric Power Research Inst., Palo Alto, CA (USA); GEOMET Technologies, Inc., Germantown, MD (USA)). Aug 1988. 63p. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016699/JAW.

A broad range of occupant activities was simulated by technicians in one of GEOMET's research houses to provide a stronger basis for transferring results from the research houses to occupied settings. These activities included opening windows as well as varying the usage patterns for appliances that can affect indoor pollutant levels or ventilation rates. Indoor levels of pollutants from unvented combustion sources did not vary substantially across three different general activity levels that were investigated. Changes in daily average air exchange (maximum increase of 0.07 air changes per hour) or total daily energy use for heating in winter (maximum decrease of 10 kWh) due to simulated occupant activities do not alter conclusions from Phase I of this study, namely, that retrofit for tightness significantly reduces air infiltration and energy use for heating. 11 figs., 11 tabs.

51485 (ETSU-S—1177) Thermal comfort assessment. A new approach to comfort criteria in buildings. Final report. Baillie, A.P.; Griffiths, I.D.; Huber, J.W. (Surrey Univ., Guildford (UK). Dept. of Psychology). (UKAEA Harwell Lab. Energy Technology Div.). 1988. 95p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The research reported deals with the development and testing of new procedures for the assessment of thermal comfort in buildings, with particular reference to passive solar heating. An Environmental Comfort Assessment Procedure has been devised, based on the feature people were found to take into account when judging comfort in an indoor environment. This has been applied to create a database of information about buildings, indoor conditions and subjective assessments, to seek further evidence regarding desired temperature levels, to identify environmental, psychological and social factors which influence thermal comfort and to indicate possible improvements to current comfort criteria for use in simulation models and design tools.

51486 (GB—137) Energy efficiency in buildings. Further and higher education buildings. (Department of Energy, London (UK). Energy Efficiency Office). Mar 1988. 25p. NTIS (US Sales Only), PC A03. Order Number DE88753997/JAW.

The booklet presented shows you how to compare the energy efficiency of a group of further or higher education buildings with that of a representative sample of similar types. This comparison will indicate whether the campus is energy efficient or if significant improvements are possible. The booklet also describes the kinds of measures that can be undertaken to save money. Many of these measures cost nothing to implement and can do much to enhance the comfort conditions in which the staff and students work.

51487 (GB—138) Energy efficiency in buildings. Health care buildings. (Department of Energy, London (UK). Energy Efficiency Office). Mar 1988. 25p. NTIS (US Sales Only), PC A03. Order Number DE88753998/JAW.

The booklet presented is designed to help in assessing the energy performance of hospitals, nursing homes and clinics. Carrying out the simple steps shown will enable valuable savings to be achieved, releasing money for much needed health care and treatment resources. The booklet shows how to compare an individual building's energy efficiency with those of a representative sample of similar health buildings. This comparison will indicate how energy efficient a site is and if significant improvements are possible. The booklet also describes the kinds of measure that can be undertaken to save money. Many of these measures cost nothing to implement and can do much to enhance the comfort conditions for staff and patients.

51488 **(GB—145) Energy efficiency in buildings. Shops.** (Department of Energy, London (UK). Energy Efficiency Office). Sep 1987. 22p. NTIS (US Sales Only), PC A03. Order Number DE88753999/JAW.

The booklet presented is intended for managers of individual shops and supermarkets, but should also be of assistance to energy managers and managers of retail chains. It is designed to help in assessing the energy performance of retail premises ranging from small high street shops up to superstores and hypermarkets. Valuable savings will be achieved by carrying out the steps shown here, releasing money which can contribute to providing a good service at competitive prices, with opportunities for increased profitability. The booklet shows how to compare the energy consumption of an individual shop with those of a representative sample of similar retail outlets. This comparison will indicate how energy efficient the shop is and if significant improvements are possible. Also described are the kinds of measures which can be undertaken to save money.

51489 **(GB—146) Energy efficiency in buildings. Catering establishments.** (Department of Energy, London (UK). Energy Efficiency Office). Sep 1987. 18p. NTIS (US Sales Only), PC A03. Order Number DE88754000/JAW.

The booklet presented is intended for local managers of restaurants, public houses, fast food outlets and motorway service areas. It is designed to help in assessing the energy performance of these types of building. Valuable savings will be achieved by carrying out the steps shown here, releasing money which can contribute to providing a good service at economical prices, with opportunities for increased profitability. The booklet explains how to compare an individual building's energy efficiency with those of a representative sample of similar buildings. This comparison will indicate whether the establishment is energy efficient, or if significant improvements are possible. Also described are the kinds of measures which can be undertaken to save money. Many of these measures cost nothing to implement and can do much to enhance conditions in areas used by staff and customers.

51490 **(GB—150) Testing stochastic models for recursive estimation and prediction of the thermal performance of buildings.** Jones, A.Q.; Paul, J.; Everett, R.; Dexter, A. (Open Univ., Milton Keynes (UK); Oxford Univ. (GB). Dept. of Engineering). (Science and Engineering Research Council, Swindon (UK)). [1987]. 67p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Includes reprint: Multiple regression and function modelling with special reference to Pennyland and Linford housing data, Mar 1986.

Energy consumption and temperature data from housing field trials in Milton Keynes have been analyzed on time scales ranging from 1/4-yearly down to hourly. Traditional least-squares statistics and sophisticated stochastic techniques such as the Kalman filter and the method of Box and Gerbins have been used. It is found that it is vital that data sets are free of errors and for most simple data the ability to manipulate and display measurements is more important than the need for complicated analysis.

51491 **(IIUG-rep—86-7) Local energy conservation projects for disadvantaged consumers in Great Britain.** Gaskell, G. (London School of Economics and Political Science (LSE) (UK)). (Wissenschaftszentrum Berlin fuer Sozialforschung gGmbH (WZB) (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1986. 59p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754301/JAW.

This report forms part of Phase II of the multi-national study 'Consumer Energy Conservation Policies (CECP)'. It presents the results of an evaluation of a scheme of local energy conservation projects in Britain. The research included a general survey of the local projects operating in 1982, an in depth analysis of five selected projects and a survey of client householders who were helped to insulate their homes by these projects and a comparison group of non clients. These projects operate under the auspices of Neighbourhood Energy Action, a voluntary sector agency which advises local committees how to set up projects to help low income householders conserve energy and to create jobs. They offer a service of low or no-cost insulation and use various national funding sources to cover the cost of employment and materials. The more successful projects are larger in size, have been operating longer, have more flexible funding, are more committed to energy conservation and have more contacts with local agencies. Tò increase the effectiveness of services, projects should be able to give a complete insulating service including advice and attempt to target the more isolated people in their locality. (orig./HSCH).

51492 **(INDU—0020-3) Long distance hot water supply in Europe, district heating, geothermal energy, new market for the glass reinforced plastics: geothermal energy.** Sprecher, N. (Owens Corning Fiberglas, Brussels (BE)). (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 24p. (In French). (CONF-8301123—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754039/JAW.

From International colloquium on forecasting for research and industry; Valbonne, France (20 Jan 1983).

Various research and demonstration programs on hot water supply and district heating in France, Germany, Denmark, etc. are reviewed in this article: geothermal energy, solar heat, waste heat or heat from power plants. The future market evolution of the long distance heat transportation systems is analysed and its effects on the glass reinforced plastic utilization are examined up to 1990.

51493 (IZ—8601, pp 79-83) **Basic investigation of vacuum cooling grain storage silo.** Murata, Satoshi. (Kyushu Univ., Faculty of Agriculture, Fukuoka, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Fundamental theory and data of the newly developed fumigation vacuum silo have been arranged, and the analyzed results of the characteristics are reported. The pressure inside the silo was decreased to 60 Torr (8,000 Pa) with a vacuum pump, and high pressurized air was flown into the silo. The difference between this pressure and that of the upper area of the silo caused the grain mass to move upward and drop after floating awhile. The bridged substances are broken up during this process. Various factors at this time are correlative. Equations of motion were derived based on a model for the analysis of volume of the silo, weight of grain mass in the silo, and pressure and volume of the storage tank. The flow rate of air with fumigant gas after vacuum breaking and the gas adsorption on the grain substance were calculated. The diffusion equation is introduced. The development of technology for economical silo required expert knowledge of structural analysis, and the study was given up for fear of hazards in the experiment. (6 figs, 1 tab)

51494 **(JMF—8603) Survey on the highly efficient energy utilization by the application of energy saving technology.** (Japan Machinery Foundation, Tokyo). Jul 1986. 138p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770153/JAW.

This is a 1985 report on the study of a heat pump system driven by stirling engine and gas engine which is the outcome of the study on the cogeneration system made in 1984 by the Japan Society of Industrial Machinery Manufacturers. Calculation of effect was made on the air conditioning and hot water supply systems at a residential house and a small scale family restaurant. For the former, energy saving of 35 % by SEHP and 26 % by GEHP was calculated in comparison with a conventional system of motor HP and multiple water heater. For the latter wherein the utilization efficiency of wasted energy is low, the energy saving was 26 % and 13 % respectively. Concerning the economy of the system, the former (6 - 13 years depreciation) had 47 % and the latter (3 years depreciation) had 21 % increase in allowance cost over the equipment cost with motor HP. Demand potential is 1.7 million unit per year (compact size) for the residential use and 4000 units per year (large size) and 13 thousand units (compact size) for the commercial use. (93 figs, 46 tabs, 6 refs)

51495 (KTM/E-D—145) Industrial ventilation design; supply air distribution. Tapola, M.; Uimonen, J.; Heinaenen, S.; Hagner, B. (Air-Ix Oy, Helsinki (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). 1987. 106p. (In Finnish). NTIS (US Sales Only), PC A06. Order Number DE88754401/JAW.

In order to study the performance of general ventilation systems a series of empirical tests were carried out in various types of industrial environments. These field studies were carried out in eleven industrial premises. In some cases the studies were repeated under various load conditions. The empirical testing methods used were tracer gas technique, temperature field, air hygiene quality and air technique measurements. Tracer gas technique was used to monitor the movement of impurity emissions and the ventilation effectiveness as well as the air exhange rate. Moreover, the indoor air quality of the installations was monitored by temperature and concentration measurements. The systems were compared on the basis of the results obtained and the economical comparison reflected both equal air quality and ventilation effectiveness. This comparison model for displacing and mixing ventilation can be utilized for the preselection of ventiltion systems. In support of this reserch the references of nine industrial ventilation installations have been included.

51496 (LBL—25614) Commercial building ventilation measurements using multiple tracer gases. Fisk, W.J.; Prill, R.J.; Seppanen, O. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 18p. (CONF-8809127—1). NTIS, PC A03/MF A01. Order Number DE88016671/JAW.

From 9. AIVC conference on effective ventilation; Ghent, Belgium (12 Sep 1988).

Researchers in the US have reported the results of measuring the nominal ventilation rate, i.e., outside air supply rate per unit building volume, in approximately 50 US commercial buildings. The nominal ventilation rate, and parameters that can be derived from the nominal ventilation rate, are sufficient for characterizing the rate of ventilation rate of ventilation only in buildings where the air is thoroughly mixed. Data that indicate the extent to which air is mixed in commercial buildings are largely unavailable. Mixing may depend on building size, internal configuration, the number and type of air handlers, and numerous other factors. When the indoor air is not fully mixed, indoor air quality and building energy consumption are influenced by such factors as local ventilation rates or ages of air, the extent and direction of interzonal air flow, the pattern of air flow between locations of air supply and removal, and the associated values of air exchange efficiency. We have obtained this detailed information on ventilation by labeling each airstream of entering outside air with a distinct tracer gas, appropriate monitoring of tracer gas concentrations, and specific procedures of data analysis. This describes the technical approach, methods of evaluating the data, and the results from two buildings. 8 refs., 4 figs., 2 tabs.

51497 (MRC—M92-6/1984E) Air sealing homes for energy conservation, 2nd edition. (Marbeck Resource Consultants Ltd. (Canada)). 1984. 436p. (CE—01819). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This manual describes the air sealing of existing houses through the application of sealants, weatherstripping, air-vapour barriers, and other products and techniques. A section on the principles of air sealing convers the basic concepts of air exchange, moisture movement, and air sealing. In addition, it discusses the control of indoor air quality and the assurance of adequate combustion air supply in extremely well sealed homes. A section on assessment procedures identifies the procedures that can be used to assess individual houses to determine what air sealing measures should be undertaken. It provides an indication of priority amongst those measures and, by way of example, identifies a number of sealing packages for a variety of circumstances. A section on air sealing practices covers the various materials used for air sealing work, their characteristics, and their preferred applications. Sealing procedures are presented for each element of the house and for most situations or construction techniques likly to be encountered. Step-by-step instuctions are provided in form of worksheets which outline tools, materials, preparation, and application procedures for each case. The manual also contains a draft glossary of terms and appendices containing data sheets on various sealants and weatherstripping materials. 156 figs., 3 tabs.

51498 (MRC —M92-6/1984F) Air sealing homes for energy conservation, 2nd edition. (Marbeck Resource Consultants Ltd. (Canada)). 1984. 437p. (In French). (CE—01820). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This manual describes the air sealing of existing houses through the application of sealants, weatherstripping, air-vapour barriers, and other products and techniques. A section on the principles of air sealing convers the basic concepts of air exchange, moisture movement, and air sealing. In addition, it discusses the control of indoor air quality and the assurance of adequate combustion air supply in extremely well sealed homes. A section on assessment procedures identifies the procedures that can be used to assess individual houses to determine what air sealing measures should be undertaken. It provides an indication of priority amongst those measures and, by way of example, identifies a number of sealing packages for a variety of circumstances. A section on air sealing practices covers the various materials used for air sealing work, their characteristics, and their preferred applications. Sealing procedures are presented for each element of the house and for most situations or construction techniques likly to be encountered. Step-by-step instuctions are provided in form of worksheets which outline tools, materials, preparation, and application procedures for each case. The manual also contains a draft glossary of terms and appendices containing data sheets on various sealants and weatherstripping materials. 156 figs., 3 tabs.

51499 (NEI-DK—95) Analysis of electricity consumption and saving potential in the public sector. Buhl Pedersen, P.; Viegand, J.; Noergaard, J.S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Jan 1988. 104p. (In Danish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754409/JAW.

The report contains a survey of the electricity consumption of the public sector and analyses the potential of energy saving. The public sector includes schools, homes and hospitals, public offices and public utility plants. Saving of electricity is defined as the technical possibilities and as the attitudes of the consumers. The conclusion of the report is that there is considerable savings to achieve by changing of attitudes and that an extra effort regarding research in technology should be made. 58 refs. (SM).

51500 (ORNL/Sub—7715/6) Thermal resistance of wall cavities containing reflective insulation. Han, B.J.; Yarbrough, D.W. (Oak Ridge National Lab., TN (USA); Tennessee Technological Univ., Cookeville (USA)). Aug 1988. Contract AC05-84OR21400. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88015326/JAW.

The thermal resistance (R) for standard wall cavities containing reflective insulation has been determined by numerically solving the Navier-Stokes and macroscopic energy balance equations for temperature and velocity distributions using the Boussinesq approximation. The numerical solutions were used to determine Nusselt numbers (Nu) for rectangular air-filled cavities with aspect ratios (A), height divided by thickness ranging from 4 to 240, Prandtl number equal to 0.7, and specific heat ratio equal to 1.4. The range of A values for which results were obtained includes values present in reflective insulation assemblies. Calculated Nu for isothermal vertical surfaces for $26.4 \leqq A \leqq 240$ are 4 to 42{percent} lower than values currently used to predict R-values for reflective assemblies. The introduction of vertical temperature gradients on the cavity boundaries increased the calculated Nu. The results of the present study permit a prediction of the total thermal resistance of a wall cavity with installed reflective insulation. The present values for R-value are significantly greater than those from previous steady-state calculations. The present results show a dependence of R-value on the service temperature gradient and a

large decrease in the predicted R-value with increasing gradient. 54 refs, 25 figs, 4 tabs.

51501 **(PB—88-213269/XAB) Fire-hazard analysis: foam-plastic insulation in exterior walls of buildings. Technical report.** Belles, D.W. (Belles (Donald W.), Madison, TN (USA)). Jan 1982. 21p. NTIS, PC A03.

Conservation represents a viable and available energy option. By insulating buildings with foamed plastic, one of the most cost-effective insulating materials currently available, energy consumption can generally be reduced. A review of the potential flammability hazards associated with the use of foam plastic insulation in exterior walls of buildings and a discussion of various special laboratory and full-scale fire testing procedures are included.

51502 **(PB—88-224647/XAB) Joint US-Romanian seminar on earthquakes and energy. Volume 1. Introduction and summary.** Aroni, S.; Constantinescu, R. (Architectural Research Centers Consortium, Inc., Washington, DC (USA)). 1987. 67p. NTIS, PC A04/MF A01.

See also Volume 2, PB—88-224688.

This volume describes presentations and discussions on the subject of earthquakes covered the spectrum of seismic vulnerability and behavior of buildings, urban systems, and critical facilities, as well as human behavior and injuries during earthquakes. Those dealing with energy conservation included solar passive and active systems, retrofitting, daylight applications, total building performance, and problems of energy conservation at an urban scale. Brief summaries are given of each of the seventy papers presented at the seminar. Technical visits to experimental facilities, the Jassy branch of ICCPDC, and a number of housing projects with special energy installations are described. Finally, ideas and topics are presented for future research and cooperation on earthquakes and energy. Full texts of the papers are available in other volumes.

51503 **(PNL—6324) Statistical comparison of the performance of heat pump, solar, and conventional water heaters in the Pacific Northwest.** Bamberger, J.A.; Hanlen, R.C.; Le Baron, B.A.; Nicholson, W.L.; Zimmerman, P.W. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016120/JAW.

As a part of its overall efforts to encourage individual homeowners to conserve energy, Bonneville offered financial incentives through certain utilities to install heat pump and solar water heaters. These devices may offer the homeowner substantial energy savings, depending upon the equipment type and the site characteristics. Bonneville has a cooperative agreement with the Oregon Department of Energy (ODOE) to: identify and monitor 500 to 700 installed heat pump or solar heat water heaters in the Bonneville service region; provide site characteristics for the installations, including costs; measure electrical energy consumption for water heating; produce good quality data on computer tape; and report on data collection efforts. This data, combined with similar data for conventional electrical resistance water heaters, can be used to provide the basis for an accurate estimate of the energy savings potential of these advanced technologies. 2 refs., 31 figs., 33 tabs.

51504 **(PNL-SA—14867) Free-piston Stirling engine-driven heat pump program plan.** Ross, B.A.; Hutchinson, R.A.; Chen, F.C. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 7p. (CONF-870804—48). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014766/JAW.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Stirling engine driven heat pumps are one of the most attractive potential products based on Stirling engines. Their many advantages in efficiency, fuel adaptability, quietness, compactness, controllability and potential for high reliability are well known. This paper briefly reviews these advantages, then turns to key technical concerns in Sterling engine driven heat pump development. These have been organized into an effective development program that will require about $4 million per year for 8 years to complete basic research, component development, and an estimated 3 generations of system hardware. The planning effort was directed by the Building Equipment Division of the DOE Office of Buildings and Communities Systems. 7 refs., 2 figs.

51505 **(PNL-SA—15354) Assessing radon control options in new energy-efficient homes.** Baechler, M.C.; Bamberger, J.A.; Foley, L.O.; Sandusky, W.F.; Harris, J. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 17p. (CONF-880679—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014754/JAW.

From 81. annual meeting of Air Pollution Control Association; Dallas, TX, USA (1 Jun 1988).

The purpose of this paper is to explore the effectiveness of several proposed construction and ventilation strategies to control indoor air quality (IAQ), especially radon concentration in energy-efficient new homes. Different techniques are analyzed for maintaining IAQ comparable to that found in homes built using current construction practices. The key health effect for the analysis is cancer from exposure to radon. We estimate the number of lifetime cancers that may occur per 100,000 persons exposed to various levels of radon that may be found in energy-efficient homes. 2 refs., 2 figs., 3 tabs.

51506 **(PNL-SA—15722) Comparison of sky luminance maps with instantaneous all-sky images.** LeBaron, B.A.; Michalsky, J.J.; Larsen, N.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 11p. (CONF-880615—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014752/JAW.

From Solar '88: American Solar Energy Society annual meeting and 13th national passive solar conference; Cambridge, MA, USA (18 Jun 1988).

Daylighting designers and modelers require more information than can be provided by measures of the the total illuminance arriving at a surface. A knowledge of the luminance spatial distribution is critical to predicting interior penetration and reflection. A qualitative comparison of contour maps, generated from a series of point measurements around the sky dome, and concurrent instantaneous all-sky photographs is made for clear, overcast, and partly cloudy conditions. It is shown that a discrete set of all-sky measurements, requiring 3 minutes to complete, are adequate to qualitatively capture the structure in the luminance distribution, even under rapidly changing cloud conditions. The models examined, performed reasonably well for the clear and overcast sky when conditions were symmetric and stable, but were unsatisfactory for the anisotropy exhibited under partly cloudy skys. The comparisons suggest that scanning instruments can quantify the essential features of a luminance distribution for conditions of high anisotropy.

51507 **(SMS—82-151) School retrofit program (enerschool). Final report.** (Scouten, Mitchell, Sigurdonson and Associates Ltd., Winnipeg, Manitoba (Canada)). Dec 1985. 136p. (CE—01875). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An energy saving retrofitting program was initiated to test and demonstrate various energy conservation techniques in Manitoba schools. Each of the 20 schools described in this report was allocated a capital cost allowance related to its physical size. One Winnipeg school and one northern school were selected as major retrofits and had a high capital cost allowance. Program objectives included proving the reliability and cost-effectiveness of energy conservation retrofits, and developing public awareness of energy retrofit potential. Consultants conducted detailed energy audits of each school to analyze and recommend means and methods for conserving energy. The average estimated annual energy reduction for Winnipeg, rural, and northern schools were 17%, 31% and 24% respectively. Cost savings and payback periods were also estimated for each schools, with average payback periods of 4.3, 1.14 and 2.06 years for Winnipeg, rural, and northern schools respectively. In the case of the two major retrofits, the payback period was 2.9 years. This study has indicated that the payback period for sensible retrofits should be less than 5 years, regardless of school location or size. Translated to the province as a whole, the cost saving potential for retrofits is in excess of $4.5 million a year. Major retrofit options for schools were found to be architectural options, such as

adding insulation and weatherstripping; mechanical options, such as improved control systems and ventilation equipment; and electrical options, such as better lighting systems. Within each option, the proper operation and maintenance of the relevant system can provide a substantial portion of the total energy saving. 25 figs., 53 tabs.

51508 **(SMSA—8505) Rural arena retrofit.** (Scouten, Mitchell, Sigurson and Associates Ltd., Winnipeg, Manitoba (Canada)). May 1985. 187p. (CE—01358). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The program, which came to be known as the Arena Retrofit Program, had as its purposes the following: provide technical and financial assistance to six rural arenas in Manitoba who were prepared to implement and demonstrate energy conserving technologies, prove the reliability and cost effectiveness of retrofit for energy conservation, and develop public awareness and understanding of energy retrofit potential. The study and retrofit of six rural arenas in Manitoba has shown that excellent potential for energy conservation exists. There are approximately 200 such facilities in Manitoba, which indicates a potential energy saving of same 214,000 GJ annually and a potential energy cost saving of approximately $2 million. This, in turn, represents good potential for the construction industry, with capital expenditures which could exceed $12 million. The payback period for retrofit work on the average is less than 5 years, which indicates that even without government funding arenas should consider borrowing as a means of financing energy retrofit programs. Potential areas of major energy savings are as follows: reduction of air leakage, recovery of ice plant heat normally rejected outdoors, replacement of inefficient lighting systems, adding insulation, proper sizing of ice plant, and power factor correction in compressors. 46 figs., 13 tabs.

51509 **(STEV—1987-R3) Heat pumps. Topical changes and future prospects.** Florin, L. (Statens Energiverk, Stockholm (Sweden)). Feb 1987. 79p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754443/JAW.

The utilization of heat pumps in Sweden is reviewed. There are some 120 000 heat pumps installed, delivering about 2 500MW of heat. During 1986 the demand was decreasing and the manufacturers faced difficulties. Future development and market potentials are discussed. (G.B.).

51510 **(TVA/OP/CEM—88/14) 1987 residential energy conservation attitude survey.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Conservation and Energy Management; WESTAT, Inc., New York (USA)). 30 Sep 1987. 134p. NTIS, PC A07/MF A01. Order Number DE88016101/JAW.

The primary purpose of this survey is to provide information to TVA that will enable the Agency to compete most effectively against the gas industry in the residential segment of the fuel market. A secondary purpose is to provide information that will be used to forecast the continuing potential and importance of TVA programs and services and to predict their expected penetration in the TVA power service area. Accordingly, the survey objectives are to: determine the current climate for energy conservation within the TVA service area; determine the potential within the home heating/cooling market for heat pumps; and measure price elasticity.

51511 **(UNIES—8503) Town energy audit match.** (UNIES Ltd., Winnipeg, Manitoba (Canada); Appin Solar Associates, Inc., Winnipeg, Manitoba (Canada); Faraci (E.J.) and Associates Ltd., Winnipeg, Manitoba (Canada)). Mar 1985. 133p. (CE—01351). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

T.E.A.M., the Town Energy Audit Match, was a multi-sector energy conservation pilot project whose broad objectives were to demonstrate the potential of energy conservation in two Manitoba communities and make available the acquired knowledge to other communities in Canada. T.E.A.M. considered the residential, municipal, industrial, commercial, institutional and transportation sectors. Each sector of the two towns was subjected to detailed energy audits to identify opportunities for energy savings. To encourage participation between the two towns, with the winner receiving a cash award to assist with a major energy conservation retrofit. Under the Residential Module, an audit delivery system was established which performed 641 residential audits, representing 50% of the housing stock in the two towns. As part of the Municipal Module, five municipal facilities in each town were audited, with one in each town receiving a major conservation retrofit. The Transportation Module consisted of fuel economy diagnostic clinics in which 878 vehicles had their engine performance evaluated, engine timing and air/fuel mixture adjusted and tire pressure checked. The Industrial/Commercial/Institutional Module provided energy audits to 42 buildings. A Statistical Base Module was also created to monitor the effects of the other modules and to administer the competition-related aspects of the project. The T.E.A.M. project provided valuable insights on the delivery of energy conservation programs and generated a better understanding on how future energy conservation programs, either single or multi-sector, could be delivered. 7 refs.

51512 **(UT/CES—8015270) Technical potential for electrical energy conservation and peak demand reduction in Texas buildings.** Hunn, B.D.; Baughman, M.L.; Silver, S.C.; Rosenfeld, A.H.; Akbari, H. (Texas Univ., Austin (USA). Center for Energy Studies; Lawrence Berkeley Lab., CA (USA)). Feb 1986. Contract AC03-76SF00098. 309p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88015270/JAW.

This report presents the results of a preliminary study of the potential for electricity conservation and peak demand reduction in the Texas buildings sector. The results show that with implementation over 20 years of cost-effective measures identified in this study (those with costs of conserved energy less than 8{cents}/kWh), potential electricity savings of approximately 50 billion kWh/yr are indicated. These savings are nearly one-third of the statewide building electricity use projected at frozen efficiency (that is, with no additional energy conservation efforts beyond 1980 characteristics) for the year 2000. Stated another way, these savings are approximately equivalent to the annual output of 10 large (1,000 MW) power plants. Alternatively, the corresponding potential reduction in peak demand is 10,000 MW (at costs less than $1,700/kW), about one-third of the year 2000 peak demand if none of these measures is implemented. 33 refs., 92 figs., 53 tabs.

3202 Transportation

REFER ALSO TO CITATION(S) 50630, 50641, 50891, 51467, 51511

51513 **(DLC—TP3764) SSTOP program enhancements. Vol. 1. Final report.** (DelCan DeLeuw Canada Ltd.). Jul 1982. 54p. (CE—01477). International Development Research Centre, 60 Queen St., P.O. Box 8500, Ottawa, Ont., Canada K1G 3H9; $N/C.

The SSTOP program was developed in Canada as a tool for optimizing traffic signal timings and offsets. The main objectives of the SSTOP enhancements were to provide fuel consumption estimates, sensitivity analysis improvements, and theoretical refinements in order to increase the overall performance of the program. The addition of fuel consumption estimates and economic analysis to SSTOP provides the user with extra measures of effectiveness in order to evaluate data which are a direct result of the timing plans. Sensitivity analysis enhancements provide the user with greater modelling capabilities by specifying volume conversion factors and stop penalties to individual links. Theoretical enhancements to SSTOP have increased the accuracy of the Random Delay component, which in turn will provide a more realistic estimate of potential fuel consumption savings under various scenarios. The SSTOP program enhancements were tested on a network of five signalized intersections. A manual review of the SSTOP output concluded that the program produced results which compare favourably with manual results based on engineering judgement and experience.

51514 **(LEMA—82-134) The fuel-saving potential of road speed governors on commercial trucks.** (Ludwick (E.M.) and Associates, Winnipeg, Manitoba (Canada)). Mar 1985. 115p. (CE—01357). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1, $0.34CAN per page, $3.40 CAN minimum.

The original objective of this project was to demonstrate the effect on fuel consumption of the application of road speed governors and anti-idling devices to commercial trucks. The term road speed governor is used to describe devices which alter driver behaviour by controlling highway speed mechanically and/or electronically. An anti-idling device reduces fuel consumption by shutting engines down instead of allowing them to idle during lengthy stops. The project design included an evaluation of alternative test devices, and development of an experimental design for conducting tests. This report covers the following: before and after fuel economy results of one motor carrier conducting tests, intra-fleet comparisons of different types of trucks and governing systems currently in place with another motor carrier, and a two year annual fuel consumption analysis of a third company operating without road speed governors in one year and with road speed governors in the next year. The results indicate that, within the study group, the use of road speed governors could reduce fuel consumption, but the magnitude of fuel saving was very user specific. Potential benefits are affected by the degree of conservation awareness throughout a company. Those carriers already practicing speed control and those who equip their vehicles for optimal fuel economy are likely to benefit less. There is some indication that the use of governors could provide a cost effective way for a carrier achieving poor fuel economy to equalize with other carriers. The three carriers in this study achieved roughly equivalent average fuel economies of approximately 6 miles/gal after governing their fleets, despite different fuel economies prior to the test. 1 ref., 2 figs., 1 tab.

51515 **(NAL-TM—563) Axial compression buckling test on structural element models for H-2 rocket satellite fairing (aluminum surface plate/aluminum honeycomb sandwich curved plates).** Endo, Shuji; Noguchi, Yoshio; Otake, Kunihiko; Ono, Koichi; Fukushima, Yukio. (National Aerospace Lab., Chofu, Tokyo (Japan)). Jan 1987. 23p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770166/JAW.

In order to grasp the complicated buckling behavior peculiar to the honeycomb sandwich structures for satellite fairing, and to obtain the basic materials which are useful for the structural design of fairings, the axial compression buckling test on aluminum honeycomb sandwich curved plates was carried out. The number of specimens was three, and their material composition was the same, but the forms and dimensions were slightly changed. In the test, two specimens caused the local buckling around 12 t, and broke down by the overall buckling around 15 t. Another specimen broke down around 12 t almost simultaneously with the local buckling. It was confirmed that the equation used for calculating the buckling load gave the comparatively good estimation on safe side as compared with the test results. In two kinds of the plasticity reduction factor adopted in the calculation of the overall buckling, that is, the equation of Gerard and the equation of Stowell, the latter showed the better conformity to the test results. (10 figs, 4 tabs, 8 refs)

51516 **(NAL-TR—928) Measurements in the functional mock up test of the NAL QSTOL aircraft control system.** Tada, Akira; Ogawa, Toshio; Yamato, Hiroyuki; Uchida, Tadao; Okada, Noriaki. (National Aerospace Lab., Chofu, Tokyo (Japan)). Apr 1987. 29p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770161/JAW.

In the functional mock up test of the NAL QSTOL research aircraft control system, the applicability of Filtering Sample equipment to the time series digital data recording was verified. The Filtering Sample equipment was prepared from a microprocessor and the expected function was ensured by incorporating this into the preprocessor to record digital data by a minicomputer. A good anti-aliasing by the real time digital processing which was previously difficult, became possible and the cost necessary to record time series digital data was clearly lowered, especially in case of multichannels. Total measuring system was constructed by addition of FFT analyzer and fibre optics CRT to chart recorders and X-Y recorder and then the effectiveness was evaluated. (3 figs, 3 tabs, 5 photos)

51517 **(PB—88-220918/XAB) Pavement management practices. Final report.** Peterson, D.E. (National Research Council, Washington, DC (USA). Transportation Research Board). Nov 1987. 150p. (TRB/NCHRP/SYN—135). NTIS, PC A07/MF A01.

Library of Congress catalog card no. LCCCN-87-50687. Report on National Highway Research Program, Synthesis of Highway Practice.

This synthesis will be of interest to pavement designers, maintenance engineers, and others responsible for the management of highway pavements. Information is presented on pavement management systems - the established, documented procedures used to treat all activities involved in providing and sustaining pavements in an acceptable condition. As highway agencies focus more attention on maintenance and rehabilitation of highway networks, the use of some form of a pavement management system becomes increasingly important. This report of the Transportation Research Board describes the features, applicability, and used of a pavement management system and recommends five general steps for implementing a new pavement management system or improving an existing system.

51518 **(TC/RPC—IP4270) Transport Canada Energy R & D program operational planning guidelines and procedures. Vol. 1.** (Transport Canada, Ottawa, Ontario. Research Planning and Coordination Branch). May 1983. 45p. (CE—01870). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This document provides a framework for developing Transport Canada's strategic goals, operational plans and procedures to define its place within Canada's energy program. These guidelines also recognize the role and contributions of other sectors and departments. This volume outlines the considerations related to development of strategic and operational plans with specific reference to the planning year 1984-85. The strategic objectives and priorities of Transport Canada's energy program include timely and adequate technological innovation to support long-term transportation fuel use policy, measures to improve energy efficiency in the transport sector, measures to promote safe and economic introduction of alternative fuels, and measures to support timely, safe, and adequate transportation of energy commodities. Major policies and programs that support these objectives are outlined. The Canadian energy/technology environment is described with reference to how it affects energy research programs and priorities. A main factor in this environment is the price of oil and the use of petroleum products as transport fuels. This leads to an emphasis on projects involving developing energy-saving technology in certain vehicle groups (heavy trucks, trains, ships), redesigning aspects of infrastructure to reduce fuel use, and improving operational techniques to reduce fuel use. Commercialization of promising new technologies and promotion of new techniques is a major part of the overall policy objective. A hierarchy for priorities involved in program planning is presented, along with an outline for program development. 8 tabs.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 50840, 50934, 50954, 50962, 50975, 50986, 51386, 51511, 51556, 51744

51519 **(AE—8602) Grey water waste heat recovery in commercial laundries. Phase 1.** Mutual, L.; Godderis, R.A. (Adept Engineering, Calgary, Alberta (Canada)). 24 Feb 1986. 43p. (CE—01831). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A literature review and feasibility study were completed to evaluate various technologies used in grey water heat recovery systems. These efforts have led to the following conclusions. Few practical retrofits have been installed in Canada. Both laundry sites

proposed for installing a heat recovery system are significantly different in makeup of waste water, dirt and installation requirements. Estimated payback periods for the two installations are below 2.3 and 3.8 years respectively. This is based on their current loading during a low business cycle due to the recession. As business picks up, loading will increase and payback periods will be better. Different and unique considerations apply to retrofit space availablility at each site. Oportunities exist at both sites for the installation of water reuse systems. They can be incorporated in the original budget. This will reduce overall water and sewer charges and in some cases fuel charges and chemical charges. Because dirty effluent water is warmer than clean effluent water, this fact can be the basis for a simple control mechanic to separate the two. Existing machines are fitted with Henresy electrical wash cycle time controllers, which have extra circuits available for control if needed. One site has some spare equipment and vessels, and they would prefer to use their own staff for installation where possible, thereby cutting costs. It is recommended that waste heat recovery and water reuse equipment should be installed immmediately.

51520 **(CPP—88) The implementation of the steam energy saving system (SES) in a pulp mill.** Noel, G.; Gagnon, F.J. (Canadian Pulp and Paper Association, Montreal, Quebec). 1988. 5p. (CE—01816; CONF-8801110—). Canadian Pulp and Paper Association of Canada, Sun Life Building, 23rd. Floor, 1155 Metcalfe St., Montreal, P.Q., Canada H3B 2X9; $3.00 CAN.

From 74. annual meeting of the technical section, Canadian Pulp and Paper Association; Montreal, Canada (25 Jan 1988).

The implementation of the SES System, a new technology of steam condensate recovery, circumvents the energy loss problems associated with steam traps in a steam distribution network. It consists of an enclosed installation in which condensate is maintained under high pressure to prevent flash steam at any point. This paper describes application in a pulp and paper mill in which the digesters condensate and a Flakt dryer condensate are recovered without any flash steam losses. Other benefits of the system include increased boiler power available for processes and reduced maintenance. Often, an important offshoot of the SES system is the possibility to use more effectively other energy losses that were previously in excess. In the particular installation described in this report, annual savings were such as to provide a payback period of 21 months. 7 figs.

51521 **(DOE/CE/15193—T2) Separation of kraft lignin from kraft black liquor: Final report, July 1984-April 1987.** Kurple, K.R. (Kurple (Kenneth R.), Anchorville, MI (USA)). 15 Apr 1988. Contract FG01-84CE15193. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011806/JAW.

The importance of this work is related to the fact that with over 16 million tons of kraft lignin available annually, practically all of it is burned just for its heat value. In essence, kraft lignin has no real value except its heat value. The major accomplishments of this research has shown that it is possible to produce high purity kraft lignin from kraft black liquor. This patented technology represents a way of producing a material that can be utilized in a wide variety of markets. Kraft lignin that was produced using this technology was sent to major corporations who used this kraft lignin as a starting material in their chemical processes. 3 figs.

51522 **(DPC—1987) Energy conservation in investment casting moulds using Canadian industrial minerals.** Heath, K.R. (Designed Precision Casting, Inc., Brampton, Ontario (Canada)). 9 Jun 1987. 122p. (MICROLOG—88-03128). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This project was initiated to develop low-firing ceramic moulds for the investment casting industry. These moulds would conserve energy in the casting process by requiring lower firing temperatures than conventional moulds. A mould composition based on mono-aluminum phospate binders and Mg0 and molochite stuccos was developed which could be fired at temperatures as low as 650/sup 0/C (compared with 1000/sup 0/C for conventional moulds) while maintaining other essential mould properties. Such properties include green and fired strength, permeability and ease of removal after casting. Disadvantages of the developed composition include unsuitablility for autoclave dewaxing and difficulty in achieving MgO/molochite stucco homogeneity in a fluidized bed. 22 figs., 30 tabs.

51523 **(EPRI-CS—5984) Field demonstration of wastewater concentration by seeded reverse osmosis: Final report.** Hess, M.B.; Jones, G.R. (Electric Power Research Inst., Palo Alto, CA (USA); Resources Conservation Co., Bellevue, WA (USA)). Aug 1988. 173p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016213/JAW.

Objectives were to demonstrate Seeded reverse osmosis (SRO) effectiveness in concentrating typical power plant wastewaters and to develop an economic comparison of SRO with other wastewater concentration technologies. Researchers transported a previously fabricated SRO pilot unit to the Utah Power and Light Company Hunter Station for a three-phase field study. In the first phase, they operated the SRO pilot unit to recover 80% of a cooling-tower blowdown feed. During the second phase, the SRO pilot unit recovered 65% of a flue gas desulfurization (FGD) thickener overflow feed. In the third and final phase, researchers reconfigured the SRO pilot unit to evaluate simultaneously the performance of five tubular, cellulose-acetate membranes provided by four manufacturers. Using field test results, the team then completed an economic analysis comparing SRO with other wastewater treatment processes. The SRO pilot unit membranes showed no signs of fouling from inorganic scaling throughout all three phases of the field testing. However, the membranes experienced a rapid deterioration during the first two test phases. 7 refs., 37 figs., 21 tabs.

51524 **(ESC-WR—88-01) Outlook for energy consumption in the iron and steel sector.** Over, J.A.; Van Wees, F.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jan 1988. 23p. Energie Studie Centrum ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the European energy outlook conference, London, UK, 15-16 December 1987.

This presentation gives the results of a study on steel production and energy use with regard to the European Economic Countries and in particular to the Dutch steelworks 'Hoogovens' at IJmuiden. The main conclusions of the presentation are that there is a lag in growth of steel versus GNP of -3.0%; a stable steel production or perhaps a growth of 0.5% per year for the next 10 or 15 years; for a good comparison on energy requirements proper system boundaries are needed; differences in energy consumption are due to different technological process routes, variations in scale of production units and differences in local energy and raw material situation; the next 10-15 years will show a decrease of 8.5% in total energy use at 'Hoogovens' but 15% increase in electricity use. The potential for longer term is 20% decrease in total energy use and 25-100% increase in electricity use. The potential for decrease by process technology and energy conservation by equal order of magnitude (each 5-10%). Environmental measures will cost significant amounts of extra energy (5%). 3 figs., 2 refs., 11 tabs.

51525 **(GB—151) Effectiveness of utilization of electric power in arc steelmaking furnaces with oxy-gas burners.** Kurlykin, V.N.; Rabinovich, V.L.; Tuluevskii, Yu. N.; Reznik, P.I.; Arkhipov, V.M.; Pirogov, N.A. (VNIIETO - All Union Research Inst. for Electrical Engineering Equipment; Tsentroenergochermet - Central Power Administration for Ferrous Metallurgy; NIIM - Central Research Inst. for Metallurgy; Red October Steelworks). (British Library, Boston Spa. Document Supply Centre). [1987]. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754743/JAW.

The authors use the dimensionless coefficients of shape and variation for the current and the mean square current as the characteristics from which to evaluate the stability of the arcs in a furnace. The arcs can be made to run more stably by using oxy-gas burners in addition. Arc stability also depends on whether the arcs run simultaneously or successively.

51526 **(GB—152) Modernization of cooling system of roller-hearth furnaces.** Yudin, R.A. (Cherepovets Steel Rolling Works (SU)). (British Library, Boston Spa. Document Supply Centre). [1987]. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754744/JAW.

A brief examination is made of measures taken to improve the cooling system of roller-hearth furnaces. Return heating system water is now used instead of service water, and a combined chamber layout is used instead of the former sectional water flow layout. Working conditions and the quality of heat treatment have been improved as a result of the redesign.

51527 **(IC—83-181) Refrigeration heat reclaim, Monco Dairy Dauphin, Manitoba.** (Intract Consultants, Winnipeg, Manitoba (Canada)). Mar 1985. 23p. (CE—01884). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A dairy in Manitoba modified its refrigeration systems to allow heat reclaim for space heating, with consequent energy, savings, and to eliminate the cost of condenser cooling water through the replacement of the water-cooled condensers with an air-cooled condenser. Cost benefit analysis of the project showed that: energy savings from refrigeration heat reclaim are estimated to be $2,100 per year, while savings in water consumption are $5,200 per year, for a total annual savings of $7,300. With the system modifications costing $16,565, this project yields a simple payback of 2.3 years. Additional savings are expected from the reduction in operating and maintenance cost due to the elimination of pressure regulating water valves and also due to the reduced compressor head pressure. The modified system has not been in operation for a sufficient period of time to allow an estimate of operating and maintenance cost savings. Another benefit from the modified system is the shorter period of time for refrigerated space to reach the desired temperature. This project has successfully demonstrated that refrigeration heat reclaim techniques and conversion of condensers from water-cooled to air-cooled both save money, and when combined provide very attractive returns on investment. 9 figs., 2 tabs.

51528 **(KTM/E-D—147) Improvement of the controllability, raw materil, usage and energy usage of a paper machine. The final report of the PAHAPA project.** Virtanen, P.; Kaunonen, A.; Cameron, F.; Kattelus, J.; Raiskila, P. (Tampere Univ. of Technology (Finland). Control Engineering). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Jan 1988. 182p. (In Finnish). NTIS (US Sales Only), PC A09. Order Number DE88754402/JAW.

The objectives of the PAHAPA project were to develop and improve the disturbance damping properties and the controllability of paper machines and to develop control strategies for paper machines. Attention was focussed mainly on the paper machine wet end. In fulfilling these objectives it should follow that the variations in paper quality (basis weight, filler content, strength characteristics, etc) will be reduced and that break times and grade change times will be minimized. In general terms the end goal was to produce better quality paper with less waste of raw material and energy while at the same time making maximal use of the paper machine production capacity. One part of PAHAPA was concerned with consistency measurements. Both low and high consistency transmitters were tested for accuracy and reliability in the laboratory and at various paper mills. Another part of PAHAPA focussed on retention. A continously operating retention control system was constructed and tested on a newsprint machine and on a SC-paper machine. In the largest part of PAHAPA a modular dynmic computer simulator of paper machine and its wet end was built. Measurements taken from a number of different paper mills were used to verify the simulator. The simulator was used to develop control straegies for the paper machine, in particular for the headbox, for the steam system of the paper machine drying section, and for control of paper quality variables. Simulation results were tested on a pilot plant machine. The simulator also includes provision for the optimal design of multi-delay lines in the wet end.

51529 **(KTM/E-D—150) Planning; realization and inspection of insulation in processes.** Numminen, P.J.; Laehteenmaeki, S.; Hellstedt, J.; Laaksonen, A. (Air-Ix Oy, Helsinki (Finland)). (Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto). Mar 1988. 108p. (In Finnish). NTIS (US Sales Only), PC A06/MF A01, Order Number DE88754404/JAW.

With support of Ministry of trade and industry have Air-Ix Oy made the research Faults in Technically Demanding Insulating Materials Used in Processes during years 1986-1987. The aim of the research was to research at this moment the faults in process insulations and to estimate those effect on heat economy and maintenance of apparatus. A defective insulation means that the flow rate of thermal energy through a construction exceeds a norm or a precalculated value. Excessive heat transfer always leads to difference on the outer surface temperatures. The primary objective of this research was to test the usefulness of thermographic instruments for evaluating the condition of insulations. The research was made by using infrared camera in many industrial establishments the research covers a wide-range of insulation installations in low-temperature to high-temperature processes. Insulation defects are normally the result of either careless installation, wrong material choice and/or incorrect design of the insulation.

51530 **(MEM—83-158) Waste heat recovery pipe.** (Manitoba Ministry of Energy and Mines, Winnipeg (Canada)). Jul 1985. 11p. (CE—01872). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A heat pipe unit was installed at a Manitoba metal products plant to reclaim waste heat from a paint drying oven exhaust stream. The recovered heat is used for space heating. A thermosyphon design was chosen for this project to avoid cross-contamination between the air and exhaust streams, and to decrease the effect of fouling of the exchanger surfaces in the exhaust stream. The high efficiency of the heat pipe allows operation a higher level of fouling than is possible with more common heat transfer designs. The system was monitored for a one month period, and a saving of 9.2% ($337.00) of gas consumption was calculated. The savings over a full heating season was estimated to be $1,685, resulting in a simple payback period of 10.4 years for a two shift operation. 2 figs., 1 tab.

51531 **(NAL-TR—922T) Wear process during the Running-in of steel in lubricated sliding.** Suzuki, Mineo; Ludema, K.C. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770162/JAW.

Slide friction experiments were made between steel cylinders and steel disks, using liquid lubricants to study the progression of events associated with running-in. When mineral oil was used, the electrical contact resistance varied over a small range of high values owing to no metallic contact. Whereas engine oil indicated a high resistance with an intermittent zero contact resistance, and further produced lower wear, slightly higher friction and a retarded running-in. These were based on the surface film formed by the additives. When mineral oil was used, a film which was composed only of Fe_2O_3 was formed, and further the lubricated surfaces developed a conforming waviness across the sliding track. This phenomenon was based on the fact that the oxide which gathered in the entrance region abraded grooves in the steel surfaces. After the oxide was dislodged, the friction increased and the contact resistance decreased for a time, indicating that the oxide acted like a solid lubricant. (17 figs, 15 refs)

51532 **(NEI-DK—94) Analysis of electricity consumption and saving potential in agriculture and horticulture.** Buhl Pedersen, P.; Viegand, J.; Noergaard, J.S. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Jan 1988. 33p. (In Danish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754408/JAW.

The report contains a survey of the electricity consumption of the agricultural and horticultural industry and analyses the potential of energy saving. Saving of electricity is defined as the tech-

nical possibilities and as the attitudes of the consumers. The conclusion of the report is that there is possibilities of saving if technical improvements are made i.e. new machines etc. 20 refs. (SM).

51533 **(NGL—3702) Development of high temperature industrial heat pump laboratory.** (Neill and Gunter Ltd., Fredericton, New Brunswick (Canada)). Jul 1986. 69p. (CE—01832). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

In order to encourage the utilization of heat pumps and mechanical vapor compression systems in Canadian industries, a study was undertaken on the development of an appropriate high temperature industrial heat pump laboratory. A questionnaire was developed, designed to solicit feedback from various agencies, organizations, forms and individuals who could be identified as having possible interest in high temperature industrial heat pumps. The questionnaire was designed to focus on important variables including technical parameters and ranges, potential use results expected, possible user fees, any objections and other suggestions. Replies were analyzed and summarized by category. While many of the responses reflect a reasonably high interest level, relatively few expressed an interest in contracting with such a laboratory to perform testing for them. This appears to be a result of various factors including: relatively low energy prices prevalent throughout Canada, reluctance on the part of some manufacturers to contract out their development work, a tendency on the part of manufacturers to feel their products are already sufficiently developed, research capabilities already existing, or preceived to be existing, and uncertainties concerning the potential effectiveness of such a laboratory. A dedicated heat pump laboratory with even modest scope to address the parameters suggested in the survey responses could not exist without massive public funding for both initial capital and annual operations, and there is no apparent basis for supporting such public funding. It is recommended that further pursuit of a dedicated heat pump laboratory at this time be abandoned.

51534 **(OAF/AE—8610) Dairy farm exhaust air heat recovery for home heating utilizing a dual system.** MacDonald, R.D. (Ontario Ministry of Agriculture and Food, Toronto (Canada). Agricultural Energy Centre). Oct 1986. 14p. CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A dual heat pump system was installed in a dairy barn in Ontario for exhaust air heat recovery. Heat recovered was used for home heating. Monitoring from December 1985 to March 1986 indicated an average system Coefficient of Performance (COP) of only 1.2, ranging on a daily basis from 0.75 to 1.8. Modifications are required to improve the system COP, such as increased fin spacing and orientation to air flow of the barn evaporator coil, and an improved heat storage system. 7 figs.

51535 **(OAF/AE—8710) Fuel consumption for fluid operations.** Winifield, R.G. (Ontario Ministry of Agriculture and Food, Toronto (Canada). Agricultural Energy Centre). Oct 1987. 38p. (MICROLOG—88-02987). Ontario Ministry of Agriculture and Food, Agricultural Energy Centre, 801 Bay St., Main Floor, Toronto, Ont., Canada M7A 2B2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Direct fuel usage was collected from a number of Ontario agricultural producers for a variety of field operations. The objective was to establish realistic values for comparision purposes. Those who cooperated in this survey were selected on a wide variety of soil types so that comparisons of soil type, soil moisture content, tillage method, tillage depth, pass number, and combined operations could be made. Relative fuel uses also permit identification of use reductions by changing tillage or production techniques. 2 refs., 1 fig., 3 tabs.

51536 **(OME—8804) Remarks for the Association of Energy Management Analysts 2nd annual conference.** Shervill, P. (Ontario Ministry of Energy, Toronto (Canada)). 1988. 19p. (CE—01848; CONF-8804188—). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From 2. annual conference of the Association of Energy Management Analysts; Toronto, Canada (11 Apr 1988).

This presentation gives basic information on cogeneration, its current application in industrial plants, and its potential, with emphasis on cogeneration in Ontario. Present parallel generation facilities in Ontario total over 1100 MW, about 4% of total provincial generating capacity. Studies indicate a technical potential of about 10,000 MW, with about 3800 MW of financially attractive (3-5 year payback period) potential capacity in the industrial, commercial, institutional, and residential sectors. Benefits of cogeneration discussed in this presentation include improved efficiency and cost savings for the plant owner, new generation capacity at low cost and potentially improved use factors for the electric utility, and improved industrial competitiveness and low environmental effects for the province as a whole. In examining the feasibility of a cogeneration facility, the main question is deciding whether the incremental capital cost of building the plant can be recouped by producing high-value electricity. Factors that can be varied in choosing the type of plant are whether the electricty production occurs at the top or bottom end of the industrial process, the type and size of prime mover, and the payback period desired. A study on a commercial greenhouse operation showed periods from 10-11 1/2 years for a 150 KW facility, which would be too long for most businesses; however, a proposed expansion of the greenhouse would likely increase the energy requirement and decrease the payback period. The Ontario Energy Ministry is involved with cogeneration to the extent of commissioning studies to define opportunities and markets, and providing information. 8 figs., 3 tabs.

51537 **(OME—8804) Heat pumps in agricultural uses. Factsheet.** MacDonald, R.D. (Ontario Ministry of Energy, Toronto (Canada)). Apr 1986. 4p. (MICROLOG—88-02930). Ontario Ministry of Energy, Municipal and Commercial Programs, 56 Wellesley St., West, Toronto, Ont., Canada M7A 2B7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper provides an elementary introduction to heat pumps and their potential for use in Ontario agricultural applications, taking into account local climatic conditions which mean high heating loads and small cooling loads. A heat pump's ability to remove heat from a variety of sources and boost this heat to a useable temperature enables such farm uses as recovery of heat from exhaust air in livestock barns, greenhouse heating using ground water, and heat extraction from manure. Basic types of heat pumps are evaluated and compared, and their costs are estimated.

51538 **(ORNL/TM—10684) Ceramic heat exchangers: Cost estimates using a process-cost approach.** Das, S.; Curlee, T.R.; Whitaker, R.A. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88015206/JAW.

This report documents the results of a study to estimate the cost of ceramic recuperators and examine the sensitivity of recuperator cost to changes in key technical and economic parameters. The focus of the work is on high-temperature recuperators of the fixed-head, tube-and-shell type in which the tubes and headers are replaced by silicon carbide. Both extrusion and slip-casting technologies are considered for the production of ceramic tubes. Slip casting is assumed to be the method used to produce the ceramic headers. A process-cost approach, which explicitly represents the costs of each major step in a production process, is used to estimate the costs of the ceramic components of the recuperator. Previous correlation studies on the cost of metallic units are used to estimate the costs of the remaining metallic components. The primary conclusion of the report is that ceramic heat exchangers are estimated to cost significantly more than comparably sized all-metallic heat exchangers. A 1500 ft^2 ceramic recuperator, in which both the tubes

and headers are replaced by silicon carbide, is estimated to cost about 68% more than a corresponding metallic unit. A recuperator in which only the tubes are replaced by ceramics is estimated to cost about 46% more than a comparable metallic unit. 32 refs., 14 figs., 4 tabs.

51539 **(PB—88-226691/XAB) Development of aerodynamic design system for centrifugal compressors.** Nojima, N.; Nagata, B.; Kawasaki, H.; Sugitani, S. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1988. 7p. NTIS, PC E04/MF A01.

Included in Mitsubishi Heavy Industries Technical Review, Vol. 25, No. 1, 1-6(Feb 1988).

An improvement of the aerodynamic performance of centrifugal compressors for industrial use is necessary to achieve high efficiency and low energy consumption. The compressor is usually composed of many stages with different flow coefficients and the performance of each stage must be improved for the above purpose. The authors proceeded with analytical as well as experimental work to improve the performance prediction and flow analysis of centrifugal compressor stages and developed an aerodynamic design system for the centrifugal compressor stage called COMPRED-S. COMPRED-S is an excellent system for realizing the optimum design of centrifugal compressor stages and has been applied to the design of high-performance stage series with three-dimensional design impellers. The impellers have been manufactured using a 5-axis milling machine, and the performance of the new stages was tested using special test apparatus and verified to have excellent performance. The stages with excellent performance have been applied to high efficiency centrifugal compressor of the products.

51540 **(SMS—MG9996) Cogeneration and waste heat recovery.** (Scouten, Mitchell, Sigurdonson and Associates Ltd., Winnipeg, Manitoba (Canada); Cogeneration Associates Ltd., Toronto, Ontario (Canada)). 1982. 67p. (CE—01739). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this study is to assess the potential development of congeneration and waste heat recovery in Manitoba industries and to estimate the cost of such development. Cogeneration is defined as a system for the simultaneous production of electricity and useful heat for industrial processes from the same fuel source. There are four practical technologies of cycles used in cogeneration but for all practical purposes, only steam turbine and gas turbine technologies are applicable to Manitoba industries. The information for this study was obtained through a mailed survey and plant visits by qualified engineers. The capital cost of developing the cogeneration potential in Manitoba is estimated at $91,312,000 with a payback period of 36.97 years. At this payback cogeneration is not economical in Manitoba. Almost all industries in Manitoba reject heat from their industrial processes and buildings. If some of this wasted heat could be recovered and re-used, the purchases of fuel would substantially decline, saving large sums of money. The capital cost of this development would be $31 million with a payback period of 4.4 years. Additional effort is needed to make industry aware of the application of heat recovery equipment. 11 refs., 12 figs., 10 tabs.

51541 **(STU—84-3078) Fuel optimization system FOCS-RF. Description and compilation of experience.** Leden, B. (MEFOS, Luleaa (SE)). (Swedish National Board for Technical Development, Stockholm; Foundation for Metallurgical Research, Luleaa (Sweden)). 12 May 1986. 68p. (In Swedish). (STU—81-4856; MEFOS-BTF—86023/85). NTIS (US Sales Only), PC A03. Order Number DE88754448/JAW.

A general and uniform computer system for optimization of utilizing of fuel for heat treatment furnaces (type FOCS-RF) for billets has been developed. The system includes functions for fuel optimization, communication with operator, ditto with other computers, logging and alarm.

51542 **(STU—85-3953) Efficient energy utilization in forest harvesting.** Helgesson, T. (Traeteknikcentrum, Stockholm (SE)). (Swedish National Board for Technical Development, Stockholm). [1986]. 21p. (In Swedish). (STU—81-5081). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754450/JAW.

Power and energy demands of machines in forestry vary considerably during the working cycle. The possibility of decreasing the energy demand in any separate operation is limited. On the other hand our investigations reveal possibilities of a more uniform power demand by better control of the separate operations and between operations. Levelling out the energy and power consumption will make a decrease in total power demand possible. A 20% decrease of installed power would be possible by available levelling out means. In the next generation machines, further equalizing could be attained by: -installation of computerized control of boom top; -installation of serial computerized control of the entire hydraulic system, thereby steering operations towards differentiation of the peak loads and avoiding their addition; -installation of active timbering tools. To what extent decrease of installed power would be attainable, will in addition depend on development of the machine travel technique. Also in this field experiments shows that a better control of the drive momenta to the wheels would highly reduce power demand. Roughly, future machines will make today's labour at a power 40% lower.

51543 **(STU—85-4829) Efficient insulation material for furnaces. Final report.** Rensgard, A. (MEFOS, Luleaa (SE)). (Swedish National Board for Technical Development, Stockholm; Foundation for Metallurgical Research, Luleaa (Sweden)). 19 Mar 1986. 43p. (In Swedish). (MEFOS-BTF—86016). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754451/JAW.

The project aim has been to test and analyze alternatives for the improvement of heat insulation and faster regulation of temperature by utilizing light ceramic insulation materials such as ceramic fibres.

51544 **(STU—85-5074) Two-stage industrial heat pumps. A design study.** Brun, M. (Chalmers Univ. of Technology, Goeteborg (SE). Dept. of heat and power technology). (Swedish National Board for Technical Development, Stockholm). Feb 1987. 153p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754452/JAW.

The two-stage heat pump, consisting of a closed cycle in the lower part and a steam compression in the upper part, is of interest for industrial applications, such as low pressure steam generation. The behaviour of the two-stage heat pump with different working fluids, two types of compressors, screw and turbo, and various operating conditions is studied. A first program is developed with a simple model of the compressors in order to compare the performance of the heat pump with different working fluids in the lower part of the system. The second study only considers R114 and H/sub 2/O as working fluids for the two stages, respectively. The program includes a model for the intermediate heat exchanger and more elaborated models of the compressors. At full load conditions, the results show better performance for a system with turbo-compressors in both stages (turbo/turbo combination) than for a system with a screw compressor for R114 and a steam turbo-compressor (screw/turbo combination). In part load situations, the screw/turbo combination allows a wider range of variation of both the load and the evaporating temperature. The resulting performance however, is smaller in the screw/turbo combination than in the turbo/turbo one.

51545 **(STU—87-227) Catalogue on heat pump installations in Swedish industry.** Wiberg, R.; Mikaelsson, H. (AaF-Industrins Processkonsult AB, Stockholm (SE)). (Swedish National Board for Technical Development, Stockholm). May 1987. 46p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88754457/JAW.

A register of 46 heat pump installations above 500 kW in Swedish industry is presented. For each installation the following data are given: technical description, installation year, investment

cost, dimensioning data, media, capacity, temperatures, power consumption, economy, heat savings and operation experiences. (L.E.).

51546 **(STU-I—601-1986) Energy balance for a particle board factory.** Dahlen, G.; Haegglund, L. (AaF Energikonsult, Stockholm (SE)). (Swedish National Board for Technical Development, Stockholm). Dec 1986. 79p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88754464/JAW.

A mapping of energy consumption of a northern Swedish plant was made. The energy intense stages were investigated in detail and also raw material management. (G.B.).

51547 **(STU-I—606-1987) Industry's use of energy. Analysis of changes which have taken place during the period 1970-84.** Isacson, Oe.; Cordi, I.; Ewetz, J.; Wernelind, Aa. (Swedish National Board for Technical Development, Stockholm). Jan 1987. 186p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754465/JAW.

The aim is to analysing the elements behind the changes causing the reduction of energy use. The oil crisis 73/74 and 79/80 and the restructuring of industry seem to be the reason. Iron and steel industry has diminished whereas the engineering industry has developed as is the case by increased fining of products by the paper and pulp industry. Restructuring is directed from energy intense branches to the ones requiring less energy. (G.B.).

51548 **(TCI—8503) Energy recovery from dryers.** Gaber, P. (Conserver, Inc., Winnipeg, Manitoba (Canada)). Mar 1985. 25p. (CE—01352). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

An energy recovery system was installed at a laundry in Manitoba to extract heat from the hot dryer exhaust air in order to preheat outside air. This preheated air is then directed back to the secondary combustion air inlet of six dryers. The system consists of two stages of lint filters, booster exhaust and supply fans, recirculation damper, an air-to-air heat pipe heat exchanger, dryer damper, ductwork and automatic controls. Because of the inherent dryer design and the consequent uncontrollable air leakage of the dryers, the heat recovery system's projected savings were reduced by about 50%. During start-up, many changes were made. The exhaust dampers were modified to reduce lint build-up. The number of moving parts of the first stage lint filter was reduced. The dryer air leakage areas were sealed. The air supply to the secondary combustion air inlet was increased. A damper on the main supply air plenum for direct plant make-up air supply was added. From dryer tests and natural gas bill analysis, the estimated annual savings, including labour savings, operating costs, and energy savings, are $12,200. The cost of the system including engineering and the start-up modifications was about $130,000 (10.6 year simple payback) without the contribution from a government energy conservation program and $67,500 (5.5 year payback) with the constribution. 5 figs., 3 tabs.

51549 **(UCRL—21084-Vol.1) Waste minimization study: Antifreeze.** (Lawrence Livermore National Lab., CA (USA); Bechtel National, Inc., San Francisco, CA (USA)). 22 Jan 1988. Contract W-7405-ENG-48. 176p. NTIS, PC A09. Order Number DE88016117/JAW.

This report attempts to quantify the amount of antifreeze wastes generated from vehicles operated at the Livermore site and at Site 300. Further, the report discusses minimization of these wastes. Used antifreeze is collected primarily at the Motor Pool, B611, or from Heavy Equipment, B519. In addition, the Livermore site maintains vehicles from the Sandia National Laboratory across the street. There are two activities which generate antifreeze wastes. By far the largest volume of antifreeze waste is generated in the scheduled annual change out from the radiators of automobiles and heavy mobile equipment. A smaller amount may be generated from such unscheduled activities as emergency radiator repairs. Typically, radiators are drained and cleaned before any repairs are made.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 51386, 51391, 51499, 51512

51550 **(DOE/CE/26564—T1) R and D pilot plant project for evaluating a direct freeze ice slurry based district cooling system: Revised final report.** Knodel, B.D. (CBI Research Corp., Plainfield, IL (USA)). May 1988. Contract FG01-86CE26564. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88011597/JAW.

This report quantifies the potential for an ice slurry district cooling system based on an innovative direct freeze ice production technology as part of the US Department of Energy project "District Heating and Cooling Technology Research: District Cooling/Ice Slurries". The results will be used by DOE to guide R&D strategies to develop a technically viable and economically sensible ice slurry district cooling system. The project is divided into three tasks: Design and construction of a test facility, this facility includes an ice generation system, a slurry distribution system, and a thermal energy storage system; The performance of the slurry distribution system and the thermal energy storage system was evaluated; and An economic evaluation of this technology employing the test results achieved was conducted. 19 refs., 17 figs., 6 tabs.

51551 **(DOE/ID/12527—4) A computer approach to district heating favorability analysis: District heating development guide: HEATPLAN 3.0 user manual: Volume 2.** Simpson, S.J.; Bloomquist, R.G. (eds.). (Washington State Energy Office, Olympia (USA); Vattenbyggnadsbyraan, Stockholm (Sweden); Statens Raad foer Atomforskning, Stockholm (Sweden)). Jun 1987. Contract FG07-84ID12527. 119p. (WAOENG—87-17/2). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88014941/JAW.

HEATPLAN is a district heating planning tool designed for PC (personal computer) use. The program is designed to provide the user with a neighborhood-level evaluation of heat demands on the basis of land use and/or actual heat load data. HEATPLAN approaches district heating from the premise that a community's heat supplies and demands should be important determinants in the community development process. In higher latitudes, space and water heating can account for a major portion of a community's total energy consumption. Industrial processing can add still more heat demands. By integrating heat supplies and demands with traditional development determinants, a community can create a land-use arrangement that is not only more energy-efficient, but also specifically conducive to district heating. 22 figs.

51552 **(DOE/OR/21390—T15) Implementing municipal solid waste to energy systems: Workshop guide.** (Wisconsin Univ., Madison (USA)). 1986. Contract FG05-83OR21390. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88015071/JAW.

The objective of this series is twofold: first, to provide municipal and industrial leaders with a method of determining quickly whether development of a waste to energy project is feasible for their community; and second, assuming a project may be feasible, providing municipal and industrial leaders with both the information base and methodology to successfully implement a project. Technologies, markets, financing and risk allocation, legal issues and pollution control are discussed. 21 figs., 13 tabs.

51553 **(EMR—8411) Energy co-operation and heat recovery system for the town of Orangeville.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Nov 1984. 2p. (CE—01869; CONF-8804188—). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

From 2. annual conference of the Association of Energy Management Analysts; Toronto, Canada (11 Apr 1988).

Since 1978, the operations staff of the Orangeville (Ontario) Sewage Treatment Plant have been experimenting with the operation of their two-stage anaerobic digesters to optimize the process. This experimentation has led to significant increases in the production of digester gas. By 1980, the extra gas produced was more than

adequate to replace all purchased natural gas previously used for digester heating and still provide a surplus of unused gas. With expansion of the plant in 1984, the digesters were modified to incorporate the experimental concepts which had greatly improved the energy efficiency of the digester operation over the past six years. It was now felt that the amount of available surplus gas was large enough to warrant consideration of alternative ways to use it productively. Possible new uses included on-site building heating, on-site electrical power generation, and the sale of surplus heat to a nearby public school or local commercial establishment. All but the last two uses relied solely on the utilization of surplus biogas. The district heating applications required consideration of energy storage and the use of additional natural gas to meet expanded energy needs on a 24 hour basis. 1 fig.

51554 **(ENR/SE—88) A programmable controller for parking lot block heaters.** (Alberta Energy and Natural Resources, Edmonton (Canada). Scientific and Engineering Services and Research Div.). 1988. 11p. (MICROLOG—88-02851). Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, Alta., Canada T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Automobile engine block heaters and interior car warmers are used by a substantially larger percentage of Alberta motorists than in the rest of Canada. This represents a substantial wintertime electricity demand. Therefore, any method of reducing the need for block heaters and vehicle warmers can save energy and help lower the peak evening power demand. Power-saver electrical cords and timers have been used, but neither of these measures represents the optimum system that might be used in large parking lots. One system showing considerable promise is reviewed in this report. In 1985, Magna Engineering designed a control strategy for the parking lot at the University of Lethbridge using 2 proposed control schemes, each of which was designed to supply power to the plug-in circuits for different time periods according to the ambient temperature. Power consumption and energy costs for each of these schemes were compared to normal, uncontrolled operation. Substantially less energy was used with the first scheme, reducing the average load per vehicle from 800 W to 500 W. Parking lot users did not report any inconvenience or discomfort after the on-off sequencing was altered. It was concluded that this fact, combined with the potential energy and cost savings, made the system widely applicable throughout Alberta. The calculated payback period of 2-3 years makes this concept particularly attractive. 2 figs., 3 tabs.

51555 **(EPRI-EM—5913) Retrofitting a water-pumping station with adjustable speed drives: Feasibility analysis: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); CRS Sirrine, Inc., Raleigh, NC (USA); Power Electronics Applications Center, Knoxville, TN (USA)). Aug 1988. 126p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016214/JAW.

The objective of this report is to develop a generalized methodology for examining water distribution systems for adjustable speed drive (ASD) applications and to provide an example (the City of Chicago 68th Street Water Pumping Station) using the methodology. The City of Chicago water system was chosen as the candidate for analysis because it has a large service area distribution network with no storage provisions after the distribution pumps. Many industrial motors operate at only one speed or a few speeds. By speeding up or slowing down, ASDs achieve gentle startups and gradual shutdowns thereby providing plant equipment a longer life with fewer breakdowns while minimizing the energy requirements. The test program substantiated that ASDs enhance product quality and increase productivity in many industrial operations, including extended equipment life. 35 figs.

51556 **Development of design criteria for treatment of metal-containing wastewaters at Oak Ridge National Laboratory.** Patrick, G.C.; Hockenbury, M.R.; Thompson, W.T.; Begavich, J.M. (Engineering-Science, Inc., Fairfax, VA (US)). pp 819-830 of Proceedings of the 42nd industrial waste conference. Chelsea, MI; Lewis Publishers (1988). (CONF-8705302—).

From 42. Purdue industrial waste conference; West Lafayette, IN, USA (12 May 1987).

A nonradiological wastewater treatment project was initiated to establish a treatment facility for wastewaters generated at the Department of Energy's Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. The project was divided into four phases. This paper discusses only the work associated with the first phase, wastewater characterization and treatability testing, which was conducted in 1985. The second phase which includes detailed design was performed in 1986. Construction is expected to begin in late 1987 with start-up expected to begin in 1989. Specifically, this paper discusses only the work associated with characterization and treatability testing of the wastewaters for heavy metal removal. An overview of all the wastewater treatability tests including those which evaluated air stripping and carbon adsorption for removal of organic compounds has been reported by others.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 51386, 51392, 51395, 51396, 51533

51557 **(BCU/FC—7905) Economic incentives for energy conservation at the consumer level. An overview and preliminary synthesis.** Nematz, P.N. (British Columbia Univ., Vancouver (Canada). Faculty of Commerce and Business Administration). May 1979. 199p. (CE—01353). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The purpose of this research report is to identify a range of economic incentives and discincentives for the modification of energy demand at the consumer level, and to make a preliminary assessment of the effectiveness and impact of these incentive systems. An extensive typology of incentive mechanisms was to assemble and categorize theoretical expectations concerning the effectiveness of alternative incentive devices, and to assemble and categorize available international experience on the use and impact of currently emplaced economic policy mechanisms for influencing consumer energy demand. To facilitate the process of policy assessment, the report outlines several general principles of policy analysis which have an important bearing on the formulation and implementation of economic incentives in the field of energy use. These principles include the nature of economic, social, political, and environmental constraints on the decision making process. Finally, the report presents the preliminary results and analysis of questionnaires sent to all levels of government in both Canada and the USA. Current economic incentive mechanisms are listed along with replies received to date on the critical issue of effectiveness. It is concluded that Canadian policy formation and legislative activity remains markedly incomplete in the area of energy conservation, although greater resources are now being devoted to this issue. American experience has been considerably greater, but there appears to be significantly different assessments of effectiveness depending on the type and formulation of alternative economic incentives in Canada. 7 tabs.

51558 **(WU/BA—TJ163-5) The effects of information on consumers' decisions to retrofit their homes. Vol. 1.** Munro, H.; Deutscher, T. (Western Ontario Univ., London (Canada). School of Business Administration). Mar 1981. 120p. (CE—01882). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this research was to evaluate the effectiveness of the information environment related to the decision to improve the energy efficiency of the home. Effectiveness was determined by examining consumers' acquisiion and use of information and the effects of that information on the retrofit decision process. Specific issues addressed were: consumers' perception of currently available information, the extent to which they make use of such information, the impact of such information on the decision process and the problems and outcomes of that process, the additional informational needs of consumers, and the variation of these issues according to individual consumer characteristics. Data for addressing these issues were collected from a survey of homeowners in Ontario. Some of the key findings are as follows. Consumers need a

substantial amount of information to make retrofitting decisions and that currently available information would not help much. Most consumers sampled had seriously considered retrofitting, and most of these in turn actually adopted retrofit measures such as weatherstripping and insulation. The most common problem areas in deciding to retrofit included determining cost effectiveness of the measure adopted and confusion in information supplied by advertisers or contractors. Consumers' evaluations of the information acquired in their search processes, and their requests for additional information, bore strong relationships to the difficulties in the decision process. Those consumers who had prior retrofit experience and/or were strongly committed to improving home comfort encountered fewer problems. 2 figs., 18 tabs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 51516

51559 **(NAL-TM—571) Study for optimization of redundant vane-type flow-direction sensing systems and numerical analysis for design of the systems.** Kimura, Takeo; Takizawa, Minoru; Uchida, Tadao. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1987. 43p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770168/JAW.

Aiming at heightening the reliability of an alpha/beta (A/B) sensor system using a vane, and for the purpose of putting the redundant type A/B sensor system based on two-dimensional vector quality measurement in practical use, the numerical simulation for the design was carried out. It was elucidated that the redundant type A/B sensor system using a vane which is one of the observation system (air flow direction measuring instrument) is equivalent to two-dimensional vector quantity measurement regarding the evaluation of observation systems, thus the theoretical elucidation of that system has become possible. Besides, by the numerical simulation of a triaxial A/B sensor system, the basic data for the design of the system meeting the required accuracy were obtained. Moreover, it was clarified that the bias error was eliminated relatively well by this system, and it is because this system becomes the optimum arrangement when the bias error was taken in consideration. (29 figs, 14 tabs, 6 refs)

51560 **(NAL-TR—924) Numerical computation of transonic potential flow about three-demensional inlets.** Nakamura, Takashi. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1987. 12p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770164/JAW.

It is essential to solve numerically the transonic flow around the air inlet precisely and effectively in order to design the transonic aircraft nacelle/inlet. A computer algorithm was developed to compute numerically the transonic potential flow around the air inlet of fan-jet engine and others. The full potential equation in conserved form which is the pricipal equation can be solved with AF2 approximate factorization scheme. The grid used for computation was generated by the conformal mapping method. The point on central line becomes a singular point by transformation of coordinate system, so that another solution is applied to this point. This algorithm could compute the three dimensional transonic flow field about axisymmetric or asymmetric nacelle/inlet configurations with or without centerbody stably and effectively. (12 figs, 14 refs)

51561 **(NAL-TR—925T) FDM-FEM zonal method for viscous flow computations over multiple-bodies.** Nakahashi, Kazuhiro; Obayashi, Shigeru. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770163/JAW.

A hybrid method combining a finite difference method(FDM) and a finite element method(FEM) was developed to compute two and three dimensional viscous flow fields over multiple-bodies. In this computation, an implicit FDM was applied to viscous flow regions near bodies, and those FDM zones were patched by solving the remaining regions using an explicit FEM. With this zonal approach, the computational efficiency of FDM and the geometric flexibility of FEM could be obtained. This approach can further be applied to various kinds of multiple-body flow problems without modifying the basic solution procedure. Flow fields of 2-D turbine cascade and 3-D nacelle/inlet were numerically simulated by this method to validate its capabilities. Several approaches were investigated to elevate the computational efficiency of this zonal approach. (11 figs, 14 refs)

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 51062, 51446, 51494

51562 **(CONF-870762—) Proceedings of the 1987 coatings for advanced heat engines workshop.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). 1987. 440p. NTIS, PC A19/MF A01; 1; GPO Dep. Order Number DE88016198/JAW.

From Coatings for advanced heat engines workshop; Castine, ME, USA (27 Jul 1987).

This Workshop was conducted to enhance communication among those involved in coating development for improved heat engine performance and durability. We were fortunate to have Bill Goward review the steady progress and problems encountered along the way in the use of TBC in aircraft gas turbine engines. Navy contractors discussed their work toward the elusive goal of qualifying TBC for turbine airfoil applications. In the diesel community, Caterpillar and Cummins are developing TBC for combustion chamber components as part of the low heat rejection diesel engine concept. The diesel engine TBC work is based on gas turbine technology with a goal of more than twice the thickness used on gas turbine engine components. Adoption of TBC in production for diesel engines could justify a new generation of plasma spray coating equipment. Increasing interests in tribology were evident in this Workshop. Coatings have a significant role in reducing friction and wear under greater mechanical loadings at higher temperatures. The emergence of a high temperature synthetic lubricant could have an enormous impact on diesel engine design and operating conditions. The proven coating processes such as plasma spray, electron-beam physical vapor deposition, sputtering, and chemical vapor deposition have shown enhanced capabilities, particularly with microprocessor controls. Also, the newer coating schemes such as ion implantation and cathodic arc are demonstrating intriguing potential for engine applications. Coatings will play an expanding role in higher efficiency, more durable heat engines.

51563 **(CONF-880760—3) Guided elastic interface waves for ceramic joint evaluation.** Simpson, W.A. Jr.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01. Order Number DE88016790/JAW.

From Review of progress in quantitative nondestructive evaluation; La Jolla, CA, USA (31 Jul 1988).

Because of their excellent thermal and wear properties, structural ceramics are finding increasing use in applications that have traditionally been reserved for metals. Since many ceramics remain stables at temperatures well in excess of the melting points of virtually all of the common structural metals, one such application is in high-temperature engines, where the relatively low weight of ceramics provides an additional advantage over such competitors as refractory metals. Unfortunately, with the relatively low fracture toughness and poor machinability of ceramics, practical designs, at least for the near future, will probably consist of ceramic liners attached to metal substrates, thereby combining the wear and thermal properties of ceramics with the strength of metals. This configuration introduces new problems, however, since one must now guarantee the integrity of the ceramic-to-metal joint as well as that of the component parts themselves. In considering possible nondestructive techniques to achieve the goals of bond strength determination and assessment of the elastic properties of the materials in and adjacent to the bond, it is clear that conventional elastic bulk waves will be of limited usefulness. However, if one could propagate an elastic wave along the bond layer, and which was evanescent in the materials on either side of the bond, then both goals

could possibly be achieved simultaneously. This report discusses this approach.

51564 **(DE—8208) Evaluation of potential improvements in automobile fuel consumption at low temperatures. Phase 2. Final report.** (Davis Engineering Ltd., Ottawa, Ontario (Canada)). Aug 1982. vp. (CE—01866). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A test program was conducted to evaluate specific engine modifications for fuel consumption, exhaust emissions, and driveability at low ambient temperatures. The following modifications were tested and compared with unmodified Omni/Horizon 1.7 litre cars: optimum cold spark timing (OCT), automatic idle speed control (AIS), and a propane fuel system. Fuel consumption and exhaust emission measurements were made at +25/sup 0/C, 0/sup 0/C, and -20/sup 0/C. The propane fuel car was also tested at -35/sup 0/C. Driveability was evaluated using a Chrysler rating procedure. The test results indicated significant fuel consumption improvements during engine warm-up at cold ambient temperatures for both gasoline engine modifications. OCT increased hydrocarbon and oxides of nitrogen emissions during the cold transient portion of the city cycle at all temperatures, although the effect on overall city cycle emissions at +25/sup 0/C was very small. AIS substantially reduced hydrocarbon emissions during the city cycle at all temperatures but increased CO emissions at +25/sup 0/C. The propane fuel car showed less fuel consumption degradation with cold temperatures than the gasoline cars. At all temperatures, it emitted lower hydrocarbons and CO, but higher oxides of nitrogen, than the base gasoline car on the city cycle. All emissions measured were lower on the highway cycle. Driveability was not significantly affected by any of the modifications, except that the propane vehicle displayed severe vaporization problems that prevented immediate drive away after a cold start at low temperatures. Use of a block heater prior to starting eliminated the problem. 7 refs., 145 figs., 41 tabs.

51565 **(EPRI-AP—5964) Advanced impingement-cooled transition piece: Testing and field demonstration: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., Schenectady, NY (USA). Turbine Technology Lab.). Aug 1988. 41p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016697/JAW.

The objective of the Advanced Cooled Engine (ACE) program was to demonstrate by extensive laboratory and field testing the performance and durability of an impingement-cooled gas turbine transition piece which is similar to that included in the new General Electric MS7001F gas turbine. The transition piece ducts hot gases from the combustion liner to the inlet of the power turbine. The concept significantly reduces transition piece metal temperatures and makes them more spatially uniform. Reduction of peak metal temperatures is essential for growth in gas turbine firing temperatures to levels necessary for next generation gas turbines, while achieving the transition piece durability and reliability necessary for commercial service. 1 ref., 28 figs.

51566 **(JMF—8601) Study on the future of ceramic gas turbines.** (Japan Machinery Foundation, Tokyo). Mar 1986. 132p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770152/JAW.

This is a study by the Japan Machinery Federation as one of the research theme in 1985 on the comprehensive energy utilization. Present status of CGT development in the world and its prospect were examined. Target is the development of 100 KW class and 300 KW class engines with 40 - 45 % thermal efficiency, light weight 1.8 - 2.0 kg/KW for transportation. Four structural types are described. Development items are diversified as main CGT body, ceramic part, fuel, periphery and application technology. Development schedule is 8 years. Effect of development is an energy-saving of 2.1 million kl per year in the industrial and transportational areas, as well as the diversification of fuel, energy-saving, environmental adaptability, and development of new fields. (44 figs, 19 tabs)

51567 **(STU-I—590-1986) Piston engine technics. Technical description - Problems survey.** Valdsoo, T. (Kungl. tekniska hoegskolan, Stockholm (Sweden). Inst. f. flygteknik). (Swedish National Board for Technical Development, Stockholm). Jan 1986. 132p. (In Swedish). NTIS (US Sales Only), PC A07. Order Number DE88754460/JAW.

The report describes the present research and development situation of the piston engine technics. The heat engine combustion process, particularly in piston engines, is treated both fundamentally and in practise. The fuel/engine connection is described both from supply and quality viewpoints. Energy utilization in piston engines and environmental interference is treated in detail. Possibilities of improvements e.g. by electronic control systems and new materials are described.

51568 **(STU-I—592-1986) Alternative heat engines. Technical description - Problems survey.** Egnell, R. (Aspen Utvecklings AB, Lerum (Sweden)). (Swedish National Board for Technical Development, Stockholm). Sep 1986. 224p. (In Swedish). NTIS (US Sales Only), PC A10. Order Number DE88754462/JAW.

The report describes the present situation of research and development on alternative heat engines. The description is limited primarily to steam engines, gas turbine engines and Stirling engines. With 134 refs.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 51446, 51494, 51563, 51568

3303 Electric-powered Systems

51569 **(STU-I—591-1986) Electric vehicles. Technical description - Problems survey.** Johansson, A. (3K Engineering AB, Stockholm (Sweden)). (Swedish National Board for Technical Development, Stockholm). Sep 1986. 123p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88754461/JAW.

The report deals with electric battery powered vehicles for road traffic, mainly in urban areas. Application technique and costs of automobiles are treated with special emphasis on Swedish conditions.

51570 **(TVA/OP/EDT—88/24) Test and evaluation of the Brown, Boveri and CIE Veritron electric vehicle battery charger.** Keller, A.S.; Driggans, R.L. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology; Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 77p. NTIS, PC A05/MF A01. Order Number DE88016104/JAW.

The BBC Veritron lead-acid battery charger was tested by TVA at its Electric Vehicle Test Facility in Chattanooga, Tennessee. The charger was tested to determine its operating characteristics while recharging an electric vehicle traction battery. The BBC Veritron charger was manufactured by the High-Energy Battery and Electric Vehicle Division of Brown, Boveri & Cie AG in Lampertheim, West Germany. It is a prototype integrated charger/vehicle controller originally constructed for use in the CitySTROMer electric vehicle (EV). The Veritron charger was designed to recharge a 96 volt (48 cell) Hagen Batterie AG 3*5PzS143 lead-acid battery pack which has an automatic electrolyte circulation system. The BBC charger was used to recharge the pack of 16 Hagen 6-volt modules from 100-, 75-, 50-, and 25-percent depth of discharge. Measurements of input current waveform distortion and input and output characteristics, and indications of induced interference with communications equipment were made during the tests. In addition, physical characteristics and the manufacturer's nameplate ratings were recorded. As a figure of merit for use in comparing different chargers, the specific power (maximum continuous output power divided by charger weight) was calculated. Electrical measurements were made using precision volt-ampere-watt meters, frequency counters, a digital-storage oscilloscope, and a spectrum analyzer. Differential amplifiers were used to convert ungrounded high-voltage inputs to ground-referenced outputs and to provide magnitude

scaling and low-pass filtering, where necessary, of the signals input to the test instruments. A discussion of the test procedures and instrumentation is included in Section 2. A description of the BBC charger is included in Section 3 and detailed test results are presented in Section 4. 6 refs.

3304 Hybrid Systems

51571 **(STU-I—589-1986) Hybrid systems for vehicles. Technical description - Problems survey.** Pettersson, H.Aa. (Thoreb AB, Goeteborg (Sweden)). (Swedish National Board for Technical Development, Stockholm). Dec 1985. 103p. (In Swedish). NTIS (US Sales Only), PC A06. Order Number DE88754459/JAW.

The following fundamental hybrid systems are treated: -Duplex internal combustion engines in heavy vehicles. -Diesel/Otto motors combined with air pressure chambers. -Diesel/Otto motors combined with flywheels. -Diesel/Otto motors combined with battery drive. -Battery drive combined with power buffer. -Contact line combined with another propulsion system.

3306 Vehicle Design Factors

51572 **(LA—11320-MS) Transportation loads with air versus leaf spring suspensions.** Butler, T.A.; Weinacht, D.J.; Tafoya, J.I. (Los Alamos National Lab., NM (USA)). Jun 1988. Contract W-7405-ENG-36. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011563/JAW.

Data acquisition equipment was installed on a heavily loaded drop- platform trailer. Accelerations were recorded at various locations on the trailer during a trip from Los Alamos to the Nevada Test Site (NTS). Road conditions varied from paved primary and secondary highways to very rough crushed rock roads at NTS. Data for transient events, such as railroad crossings and bridges, were also recorded. Descriptions of the tractor/trailer configuration, instrumentation, and data analysis techniques are presented. Reduced data are presented in the form of power spectral density plots and response spectra (shock spectra) plots. Finally, recommended load factors for use in designing payloads that are to be transported on heavily loaded trailers are discussed.

3307 Emission Control

REFER ALSO TO CITATION(S) 51568

51573 **Environmentally sound coal-fueled diesel engines.** Carpenter, L.K.; Holcombe, N.T.; Byam, J.W. Jr. (Morgantown Energy Technology Center, WV (USA)). pp 228-231 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Due to high levels of NOx emissions, conventional diesel engines are considered to be contributors to the acid rain problem. Additionally, diesel engines emit high levels of particulates (soot). Attempts to convert these engines to coal fuels would seem to aggravate this problem, but surprisingly, initial testing has shown substantially reduced NOx emissions, and there is potential to meet existing and future standards for emissions of particulates and SOx. As a result of activities managed by the Morgantown Energy Technology Center, the economic and technical feasibility of coal-fueled diesel engines has been determined. Recently, both GE and a team of A.D. Little/Cooper Bessemer were selected for five-year contracts aimed at developing by 1993 the components and subsystems necessary for subsequent private sector demonstration and commercialization of coal-fueled diesel power systems. The development of coal-fueled systems will necessitate the application of hot gas contaminant control equipment to ensure that the systems burn coal in an environmentally sound manner. This paper will discuss the environmental concerns, the emissions goals, and the control methodologies, devices and strategies that will be used to ensure that coal-fueled diesel engines will meet current and potential environmental standards.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 50907, 50919, 51564

51574 **(CGA—8710, pp 13) NGV Diesel update.** Rich, M.M. (B.C. Hydro, Vancouver). 1987. (CONF-8710371—).

From C.G.A. marketing conference; Edmonton, Canada (18 Oct 1987).

This presentation describes the activities of a British Columbia company that converts diesel engines to natural gas operation. These activities started in 1984 with the conversion of a passenger bus. Another major project was converting a 350-ton car and passenger ferry. The engines of this ferry use a 50-50 diesel-gas fuel mix at idle, and 88% gas at cruising speed. Engine power and response is identical to operation on diesel fuel only, but engine noise is reduced noticeably. Another ferry is also being converted, and savings of $120,000/y in fuel costs are expected when both vessels are in operation. Conversions are also being carried out on trucks, including those on freight runs to the USA; natural gas refuelling is done in Vancouver and Seattle. To promote natural gas as a fuel for diesel trucks, a demonstration project was set up, involving a service station near the Trans Canada highway specially designed to fuel trucks with natural gas, to convert diesel vehicles to dual fuel operation, and to monitor the results of such conversions and disseminate this information to the diesel industry. A computerized card system enables easy monitoring of the users of the facility.

51575 **(DOE/PE—0085) Assessment of costs and benefits of flexible and alternative fuel use in the US transportation sector: Progress report two: The international experience.** (USDOE Office of Policy, Planning and Analysis, Washington, DC). Aug 1988. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016472/JAW.

This report presents case studies of the only three countries that have undertaken government efforts to use alternative transportation fuels: {ital Brazil, Canada, and New Zealand}. The fuels receiving the most attention, and the focus of this report, are ethanol (ethyl alcohol), methanol (methyl alcohol), CNG (compressed natural gas), and LPG (liquefied petroleum gas). The report also describes New Zealand's experience with natural gas-based synthetic gasoline, which is different from the other fuels because it substitutes for gasoline without modification of vehicles or the fueling infrastructure. Electric vehicle progams are also discussed briefly. 4 figs., 6 tabs.

51576 **(ESC-WR—88-10) Methanol: pure fuel for the road traffic.** Kegelaar, N.; Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Apr 1988. 64p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report on a period of practical training discusses different aspects of the use of methanol as a future motor fuel. Environmental aspects will be stressed. The first part of the report deals with the production of methanol from natural gas and by means of coal gasification. Also the methanol synthesis by means of GSSTFR (gas-solid-solid-frickleflow-reactor) and the methanol-to-gasoline process are discussed. Environmental aspects of the methanol production can be located during the winning of feedstock (oil, coal, natural gas), processing of the raw material (reforming gasification) and in the toxical characteristics of the end-product. The second part of this report deals with the use aspects and emissions of methanol as a motor fuel with regard to Otto engines and diesel engines. The emissions are discussed concerning air pollution by exhaust gas, NO/sub x/, SO/sub 2/, hydrocarbons, photochemical reactions and some other components. Technologies to limit emissions are considered, like the lean burn motor and catalytic purification. Finally an overview is given of the use of alcohols as motor fuels in Brazil, USA, West-Germany and France and the prospects for application of methanol in the Netherlands. 15 figs., 74 refs., 9 tabs.

51577 **(MRC/IT—MG13180) Methanol fleet test.** (Manitoba Research Council, Winnipeg (Canada). Industrial Technology Centre). Mar 1985. 137p. (CE—01741). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The objective of this project was to test and demonstrate the use of methanol as a vehicle fuel by comparing the overall performance of a fleet operating on regular unleaded gasoline with that of a fleet operating on a low methanol (test) blend. The performance of the fuels was compared by 4 tests. A weekly driver survey provided information on general driveability and operating problems. Controlled driveability testing allowed for an unbiased evaluation of vehicle driveability. Fleet fuel consumption data provided a field comparison of fuel energy economy. Chassis dynamometer testing yielded a controlled condition comparison of fuel energy economy. Higher demerits for driveability were reported initially for the test blend fleet compared to the regular umnleaded gasoline fleet. With the addtion of butane to the blended fuel during the winter months, demerits decreased for the blend test fleet. Results of line controlled driveability tests showed that there was no significant difference in driveability demerits at the 90% confidence level. Of the matched vehicle types used in the demonstration, the test blend fleet used 11.2% more energy per unit distance than the regular unleaded gasoline fleet. Chassis dynamometer testing differences were not statistically significant at a confidence level of 90%. These tests permitted a valid comparison of fuels by eliminating many of the uncontrolled conditions found in fleet operation. Experience to date shows that the methanol fuel can be formulated to give similar driveability to seasonally adjusted gasoline. As only one winter of operation had been completed, further testing was recommended. 4 refs., 21 figs., 32 tabs.

51578 **(STU—86-2028) M100-vehicles. Planning, development.** Brandberg, Aa. (Svensk Drivmedelsteknik AB, Stockholm (SE)). (Swedish National Board for Technical Development, Stockholm). 17 Nov 1986. 15p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754453/JAW.

Experience of the M100-project and of new concepts of alcohol fuel spark ignition engines has lead to the following proposal for continued development. -Continued operation of some of the test cars to reach greater experience of wear problems and to be able to make modifications concerning engine heating time, start gas consumption and exhaust gas purification. -Measurement of evaporation emissions and exhaust gas emissions on modified and new concepts through standardized procedures an in particular by cold driving cycles and different methanol fuels (M100-M85). -Field tests of new developed concepts with advanced exhaust gas purification; of particular interest would be 'lean burn' engines and 'flexible fuel vehicles'. -Further efforts on material problems in fuel systems. (G.B.).

51579 **(STU-I—588-1986) Application of alternative automotive fuels. Technical description - Problems survey.** Bertilsson, B.M.; Brandberg, Aa.; Pilo, C.; Laveskog, A.; Isaksson, K. (Svensk Drivmedelsteknik AB, Stockholm (Sweden)). (Swedish National Board for Technical Development, Stockholm). Jun 1986. 135p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754458/JAW.

The report describes the present research and development situation regarding alternative fuels for vehicles. Motor alcohols, natural gas and motor gas, generator gas, biogas and plant oils are treated closely. Also hydrogen is considered. The close treatment comprises background, technical status, use and a discussion of required measures.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 51407

51580 (UCRL—53615-86, pp 23-36) **Verification.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Verification Group manages and carries out projects that use LLNL's seismic, technological, and computational expertise; geologic and seismic data bases; and classified national defense and intelligence information to develop better methods for verifying compliance with test ban treaties, interpreting intelligence data, and supporting DOE personnel as they help formulate arms control agreements, negotiate treaties, and evaluate compliance. During 1986 the group directed projects in the following areas: regional seismic system performance; regional arrays and signal processing; regional discrimination; evasion and counterevasion; test ban issues; and verification technologies. Activities in all these areas, except test ban issues, are described. Recent publications are listed. 15 references.

3503 Verification

51581 **(UCRL—53830) Decision framework for evaluating compliance with the Threshold Test Ban Treaty.** Judd, B.R.; Younker, L.W.; Hannon, W.J. Jr.; Strait, R.S.; Meagher, P.C.; Sicherman, A.; Kamelgarn, M.B. (ed.). (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016119/JAW.

We have developed a decision framework for evaluating Soviet compliance with the 150-kt limit on the yield of nuclear tests, as specified by the Threshold Test Ban Treaty. The framework is designed to help interpret available evidence of possible violations and respond appropriately to that evidence. The "evidence" consists of estimates of the yield of Soviet tests. Interpreting and responding to evidence of possible violations requires a series of technical determinations and policy judgments. The decision maker may wish to consider: the degree of uncertainty in the monitoring data; potential Soviet violation scenarios and their significance; the probability of Soviet violations; the relative values of correct or incorrect responses; and the role of US responses to evidence in deterring future violations. The decision framework provides methods for incorporating explicitly each of these factors when interpreting and responding to evidence. The framework is best viewed as an aid to decision making. The intent, of course, is not to replace the policy maker with an analytic process. Rather, the framework provides a systematic method for organizing and incorporating diverse inputs, exploring the implications of alternative technical and value judgments, and understanding complex tradeoff. By exercising the framework, technical analysts and policy makers can build new insights, which ultimately can lead to better compliance evaluation decisions. 31 refs., 32 figs.

51582 **(UCRL—98846) A systems analytic view of banning chemical weapons.** Barletta, W.A. (Lawrence Livermore National Lab., CA (USA)). 19 May 1988. Contract W-7405-ENG-48. 14p. (CONF-8805160—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013816/JAW.

From International forum on total ban of chemical weapons: the problems of verification; Rome, Italy (19 May 1988).

This paper covers the historical perspective, the political perspective, and the systems analytic view of banning chemical weapons. 4 figs.

36 MATERIALS

REFER ALSO TO CITATION(S) 50343, 51380

51583 **(NKSZ—8501) FY 1985 annual report of Nissan Science Foundation.** (Nissan Kagaku Shinko Zaidan, Tokyo (Japan)). 1985. Vp. (In Japanese). Nissan Kagaku Shinko Zaidan, 6-17-2, Ginza, Chuo-ku, Tokyo.

Individual papers in scope for the data base are processed separately. (DLC)

51584 **(NKSZ—8601) Research Project in review 1985 of Nissan Science Foundation.** (Nissan Kagaku Shinko Zaidan, Tokyo (Japan)). 30 Aug 1986. Vp. (In Japanese). Nissan Kagaku Shinko Zaidan, 6-17-2, Ginza, Chuo-ku, Tokyo.

Individual papers in scope for the data base are processed separately. (DLC)

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 50357, 50362, 50363, 50837, 50838, 51077, 51105, 51105, 51106, 51122, 51153, 51200, 51244, 51244, 51278, 51278, 51515, 51525, 51526, 51531, 51565, 51674, 51716, 51735, 51781, 51823, 51910, 51911, 51916, 52726, 52754, 52755, 52772

51585 **(BARC—1379) Hydrogen diffusion in tantalum.** Anand, M.S.; Pruthi, D.D. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704073/JAW.

Using resistivity technique, the diffusion of hydrogen in tantalum has been studied in the temperature range of 298-373 K. The diffusivity values obtained obey the following Arrhenius equation: D=4.38x10/sup -4/ exp(-0.142/kT) cm/sup 2//sec. The diffusion parameters agree with those obtained by others. The data has been interpreted in terms of modified over barrier diffusion mechanism. (author). 8 refs., 1 table, 4 figures.

51586 **(BARC—1395) Galvanic corrosion of Al 1S and Al 57S in demineralised water.** Chouthai, S.S.; Shibad, P.R.; Gadiyar, H.S. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704085/JAW.

Experiments were conducted on A1-1S and A1-57S to investigate the effect of galvanic coupling between the two on the corrosion rates, on exposure to demineralised water at room temperature. The results indicated that such galvanic effects were not observed. Specimens pretreated in 2 per cent sodium oxalate and also in 3 per cent oxalic acid showed lower corrosion rates as compared to specimens without any treatment. AES studies carried out on A1-1S and A1-57S both untreated and treated in 2 per cent sodium oxalate and in 3 per cent oxalic acid solution revealed bulk of the passive film to be an oxide of aluminium with differences in thicknesses for the two materials. Thinner films were seen on A1-57S as compared to A1-1S. (author). 5 tables, 7 figures.

51587 **(BDX—613-3941) Gaussmeter determination of 302 stainless steel material condition: Final report.** O'Donnell, R.E. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Aug 1988. Contract AC04-76DP00613. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015029/JAW.

A technique was developed to non-destructively distinguish between the annealed and spring tempered condition of a 302 stainless steel component inside a mechanical assembly. A gaussmeter was used to measure the difference in magnetic flux density between the two material conditions. This method provides an accurate way of distinguishing between low strength and high strength components inside mechanical assemblies. This determination can be made after the mechanical assembly is placed into a final assembly housing. Measurements of magnetic flux density were taken with fixturing that would allow evaluation of assemblies after they were placed into final assembly housings. Further development would be required before this could be implemented successfully on final assemblies. 8 figs.

51588 **(BMI/ONWI/C—176) A review of degradation modes of low carbon steel in brine environments.** Natalie, C.A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Seton Project Development, Inc. (USA)). 25 Oct 1987. Contract AC02-87CH10290. 104p. H. Order Number TI88016506/JAW.

A literature search was conducted to review information on degradation modes of low carbon steel in brine solutions. A computer search was used to obtain articles from 1970 to present while a manual search was conducted for articles published prior to 1970. The published articles and reports indicated that uniform corrosion occurred in sea water, geothermal brines and simulated repository brines. The uniform corrosion rate increased with decreasing pH, increasing oxygen contest of brine and increasing temperature. Pitting of low carbon steel in brine solutions was related to scale formation due to presences of sulfur and heavy metal ions or mill scale present prior to exposure. Low carbon steel did not appear to be susceptible to stress corrosion cracking, but data was limited. The presence of anaerobic bacteria greatly increased the rate of corrosion of low carbon steel as compared to sterile conditions. If sufficient hydrogen is present, low carbon steel could fail due to hydrogen embrittlement in brine solutions. However, this is an area where experimental work needs to be done under more specific conditions related to salt repositories. Corrosion fatigue and stray current corrosion require specific conditions to occur which can be avoided during waste storage and were there fore not addressed. Also, galvanic effects were not addressed as it will be possible to minimize galvanic effects by design. 226 refs., 4 tabs.

51589 **(BNL—41525) Glancing angle EXAFS [Extended X-ray Absorption Fine Structure] studies of interfacial reactions: An application to Cu-Al thin films.** Chen, H.; Heald, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880623—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015973/JAW.

From 11. symposium on the reactivity of solids; Princeton, NJ, USA (19 Jun 1988).

Interface problems are important to studies of reactivity of solids. Since interfaces are often buried, a non-destructive and sensitive probe capable of examining internal interfaces is desirable. A combination of the glancing angle x-ray reflectivity and Extended X-ray Absorption Fine Structure (EXAFS) has been shown to be such a technique. This paper describes the technique and its application to the determination of Cu-Al interface structures. Cu-Al system has been well studied by other techniques, such as Rutherford Backscattering (RBS) and X-ray Diffraction. Those studies identified $CuAl_2$ as the first compound to form at the interface. Using the glancing angle x-ray probe which has higher depth resolution, the initial interface structure was shown to be different from $CuAl_2$. This paper presents further results which show that as the result of annealing treatments, a thicker interface grows with a structure that resembles $CuAl_2$. 7 refs., 4 figs., 1 tab.

51590 **(CEA-R—5448) Influence of phosphorus on point defects in an austenitic alloy.** Boulanger, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Jun 1988. 295p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88754947/JAW.

The influence of phosphorus on points defects clusters has been studied in an austenitic alloy (Fe/19% at. Cr/13% at. Ni). Clusters are observed by transmission electron microscopy. After quenching and annealing, five types of clusters produced by vacancies or phosphorus-vacancies complexes are observed whose presence depends on cooling-speed. Vacancy concentration (with 3.6 10/sup -3/ at. P) in clusters is about 10/sup -5/ and apparent vacancy migration is 2/sup +-/ 0.1 eV. These observations suggest the formation of metastable small clusters during cooling which dissociate during annealing and migrate to create the observed clusters. With phosphorus, the unfrequent formation of vacancy loops has been observed during electron irradiation. Ions irradiations show that phosphorus does not favour nucleation of interstitial loops but slowers their growth. It reduces swelling by decreasing voids diameter. Phosphorus forms vacancy complexes whose role is to increase the recombination rate and to slow vacancy migration.

51591 **(CONF-880798—1) USDOE mechanical properties data base on modified 9 Cr--1 Mo steel.** Brinkman, C.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 42p. NTIS, PC A03. Order Number DE88015308/JAW.

From USDOE/JAPC joint study working group meeting on structural design methods and data for modified 9 Cr-1Mo steel; Oak Ridge, TN, USA (12 Jul 1988).

Information on creep, tensile properties, and fracture mechanics of modified 9 Cr--1 Mo steel is presented. (CBS)

51592 **(DESY-SR—87-10) Submonolayers of lead on silicon(111) surfaces: An x-ray standing wave analysis.** Dev, B.N.; Materlik, G.; Grey, F.; Johnson, R.L. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1987. 5p. (CONF-8706334—1). NTIS (US Sales Only), PC A02. Order Number DE88012620/JAW.

From ICOSS-II conference; Amsterdam, Netherlands (1 Jun 1987).

In the present study we have applied the x-ray standing wave (XSW) technique to the Si(111) $\sqrt{3}$ {times} $\sqrt{3}$-Pb system in order to determine the position of the Pb atoms relative to the bulk Si lattice. The XSW technique makes use of the spatial periodicity and the phase tunability of standing wave fields. By making an XSW measurement with (hkl) substrate reflection one extracts the phase ({phi} relative to the substrate diffraction planes and the amplitude (f/sub c/) of the (hkl) Fourier component of the adsorbate atom density distribution function. The phase is closely related to the distance of the adatoms from the surface in the [hkl] direction and the amplitude is related to the degree of order in the overlayer. The quantities {phi} and f/sub c/ are obtained by a least-squares fit of the normalized fluorescence yield from the overlayer atoms with an expression derived from the dynamical theory of x-ray diffraction. 16 refs., 3 figs.

51593 **(DOE/ER/45143—1) Synthesis, characterization, and spectroscopic analysis of the I-II, and I-III Zintl intermetallic compounds: Final report.** Jang, Gun-Eik. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). Dec 1987. Contract FG02-84ER45143. 151p. Unlimited audience, publicly available. Gun-Eik Jang, 118 University Village, Salt Lake City, UT 84108. Order Number TI88016167/JAW.

The I-II and I-III intermetallic with B32 (Zintl) structure have recently attracted significant interest due to their unusual properties and their use as electrodes in high energy density batteries. Studies of the electronic structure should provide an understanding of the macroscopic properties of these compounds. This work focused on synthesis, characterization, and spectroscopic analysis of the Zintl compounds. Phase characterization was done by x-ray diffraction. Densities were measured by the pycnometer method. The chemical composition was determined by atomic absorption and emission spectroscopies. One large LiGa single crystal was successfully grown. The structure of the valence band was studied by photoelectron and by Auger spectroscopies. The conduction band was studied by electron energy loss. Results are discussed. 89 refs., 61 figs., 8 tabs.

51594 **(GKSS—88/E/17) Neutron scattering experiments for determination of states of order of α-Fe-Si single crystals.** Koelker, W. (Muenster Univ. (Germany, F.R.). Inst. fuer Werkstofforschung). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Muenster Univ. (Germany, F.R.). Fachbereich Physik). 1988. 124p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754831/JAW.

The state of order of α-FeSi single crystals containing 7.6 to 10.3 at.% silicon was investigated by measuring the diffraction patterns of the B2 and DO/sub 3/ superlattice reflections (200) and (111). At a silicon content of 7.6 at. % the alloy exhibits pure DO/sub 3/ order. The α solid solution consists of long-range ordered domains. On approaching the B/sub 2/ phase boundary, the domain size increases drastically. Within a single domain, the degree of order reaches its maximum value already in the α region of the currently accepted phase diagram, and therefore reveals no striking change at the phase boundary. These results lead to a new interpretation of the phase diagram. (orig./HP) With 48 figs., 15 tabs.

51595 (INIS-SU—11, pp 156-158) **Electrochemical oxidation of zirconium alloys in pre-transition and post-transition kinetic regimes at corrosion in electrolyte solutions.** Barkov, A.A.; Shavshin, V.M. (AN SSSR, Moscow. Inst. Fizicheskoj Khimii). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

With the aim of investigation on oxidation of zirconium alloys (Zr+2.5% Nb) the critical thickness of beginning of spalling of froming oxide films in HCl and NHO/sub 3/ aqueous solutions was evaluated by coulometry with accelerated procedure. Some variants of predeposition of modificated oxide coatings are proposed increase pre-transition regime time and to decrease corrosion during post-transition regime. Increase in agressivity of solutions (addition of 1 vol.% HF) and UV irradiation are found to increase 3-4 times pre-transition period. 2 figs.

51596 (INIS-SU—11, pp 173-175) **Corrosion by electrochemical impedance measurement of the anodic behaviour of Ti, Ti-Al, Ti-V and TA6V alloys in 8M hydrochloric acid.** Caprani, A.; Priem, F.; Frayret, J.P. 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Mechanism of dissolution of titanium base alloys Ti-(2-10)%Al; Ti-(2-8)% V and TA6V as well as respective roles of aluminium and vanadium are investigated on the basis of the analysis of stationary current and electrochemical impedance of anodic behaviour of the alloys in 8MHCl. The investigation results show that aluminium delays the passivity whereas vanadium inhibits TiO/sub 2/ formation and gives rise to R/sub t/I increase just before passivity inition (R/sub t/ - charge transfer resistance; I-stationary current). This result indicates to a decrease in dissolution rate corresponding to changes in charge transfer. 1 ref.

51597 (INIS-SU—11, pp 221-223) **Role of potential and metal structure in integranular corrosion of boron-containing austenitic stainless steels.** Kasparova, O.V.; Milman, V.M.; Khokhlov, N.I. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The effect of boron on the susceptibility of high-purity austenitic chromium-nickel steel type 20-20 to intergranular corrosion has been studied in 1N HClO/sub 4/+0.25NHNaCl and 1 NH/sub 2/SO/sub 4/ for different structural states. Polarization measurements in combination with microscopical and X-ray analysis methods are used. The results obtained show the detrimental effect of boron, especially in aged steel after heating at 650 deg C. The necessity for strict control of boron content in austenitic stainless steels used in agressive media is underlined. 3 refs.; 3 figs.

51598 (INIS-SU—11, pp 240-242) **Corrosion and electrochemical behaviour of amorphous and crystallic Ti-Co-P and Ti-Ni-P alloys.** Kuznetsova, E.G.; Boriskina, N.G.; Ugol'kova, T.A. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR); AN SSSR, Moscow. Inst. Metallurgii). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Effect of phosphoric additions on corrosion of Ti-Ni and Ti-Co in ION and 5N sulphuric acid has been investigated on crystalline specimens as well as on amorphous and amorphous-crystalline strips, prepared by rapid quenching from melt. Phosphorus additions are shown to improve corrosion resistance both of crystalline and amorphous alloys. Phosphorus effect manifets itself in hydrogen overvoltage decrease and in retardation of anodic decrease and in retardation of anodic process. Amorphous alloys are found to have lower corrosion rates than those in crystalline state. 3 refs.

51599 (INIS-SU—11, pp 318-320) **Temperature influence on corrosion rate of armco iron in acid solutions.** Perboni, G.; Rocchini, G. (Thermal and Nuclear Research Center, Milan (Italy)). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

An experimental study of the behaviour of Armco iron and several steels in acid solutions (HCl, H/sub 2/SO/sub 4/, H/sub 3/PO/sub 4/) has been undertaken to determine the temperature effect on dissolution rate. The test temperatures were 30, 45, 60, 75 and 90 deg C. The activation heat was determined by application of the Arrhenius law from colorimetric and electrochemical data. Investigation results obtained by both methods were represented diagrammatically and showed a good agreement, though the discrepancy in the data increased with test temperature. 4 figs.

51600 (INIS-SU—36, pp 101-108) **Influence of ion bombardment in condensation process on the niobium film structure and electrophysical properties.** Belevskij, V.P.; Gusev, I.V. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780176/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(39).

In Radiation damage physics and radiation material technology. Scientific-technical collection.

The effect of Nb ion bombardment at energy of E/sub k/ =(0.8...6.4)x10/sup -16/ J in the course of vacuum condensation on the structural characteristics (grain size, crystal lattice parameter, texture), stresses and electric properties (specific electric resistance, superconducting transition temperature) of niobium films is studied. A set of energy parameters of ion deposition permitting to describe the effect of ion radiation on the condensate is determined. The critical parameters of the process are calculated, which are the following: the effective condensation rate v/sub eff/ and specific energy of ion bombardment PHI/sub E/, in different characteristic regions of which different regularities of the ion bombardment effect on the film structure and physical properties are observed. The critical values of these parameters v/sub eff/{similar←to}v/sub m/ and PHI/sub E/{similar←to}1x10/sup -15/ J/at are determined. The experimental results testify to the fact that in different PHI/sub E/ and v/sub eff/ ranges different mechanisms of the effect of ion bombardment on the condensed film are prevailing: radiation effects on the condensation surface, ion-induced annealing of condensates, ion mixing at the interphase boundary. 20 refs.; 7 figs.

51601 **(Juel—2129) Electronic structure and superconductivity of divalent metals under very high pressure.** Bireckoven, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Koeln Univ. (Germany, F.R.)). May 1987. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754341/JAW.

A single crystal, high-pressure diamond cell has been developed for the study of superconductors under pressures to over 50 GPa. A high sensitivity AC-SQUID magnetometer has been employed to detect the diamagnetic response of the very small samples at T/sub C/. The T/sub C/(p)-dependence of the lead-manometer has been calibrated against the ruby-pressure-scale up to pressures of 30 GPa. In spite of the well-known fcc/hcp-transition at 13 GPa lead shows a smooth T/sub C/(p)-behaviour and thus is a very suitable manometer. Band structure calculations for the alkaline earth metals indicate an appreciable s-to-d transfer with increasing pressure. In fact, superconductivity was previously observed in the pressure induced d-transition metals Sr and Ba (however not yet in Ca). For the first time the author presents a quantitative investigation of T/sub C/ as a function of p up to 50 GPa. Both elements turn out to be "good" superconductors featuring T/sub C/'s of about 7 K. The possibility of a generalized phase diagram for the alkaline earth metals will be critically discussed. At any rate, the occurrence of such high T/sub C/'s is rather strong evidence for a substantial d-transition metal character at high p. Investigations of very dilute BaEu-alloys up to 45 GPa reveal a strong monotonic increase of ΔT/sub C/ = T/sub C//sup Ba/-T/sub C//sup BaEu/. (orig./GSCH).

51602 **(KFK—4214-B) Gas contrasting of multiphase and composite materials.** Nold, E.; Ondracek, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Mar 1987. 24p. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung.

The contrast between various constituents of multiphase materials is the most important factor for quantitative microstructural analysis. How to achieve it by gas contrasting is the subject of the present report, which starts in its first part with the description of the gas-contrasting chambers and the technique of gas contrasting, continues with the demonstrating and explanation of gas-contrasted metal, composite, and ceramic microstructures, and finishes with the interpretation of the gas-contrasting effect on the basis of the theory of thin interference layers. In the second part the structure of an HfC-Co hard metals was gas-contrasted for the purpose of quantitative microstructural analysis. Interference coatings were formed on the structural components in the process. These produce the desired colour contrast. Their structure is investigated using auger electron spectroscopy. It was found that, independent of the cathode material used, the coating overall contains mainly oxygen and the cathode element, that the oxygen concentration beyond a certain depth in the coating assumes approximately the value of uncoated specimen, that below this depth in the coating the cathode material can no longer be identified and that above this depth in the coating no hafnium or carbon is detectable on the HfC-phase while cobalt is present in the coating structure in the Co-phase.

51603 **(KFK—4376) Texture variations and atomic dislocations by Ar-irradiation in Au and NbN sputtered layers.** Jung, V. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Festkoerperphysik). Feb 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754350/JAW.

Irradiation of Au and NbN sputtered layers with Ar/sup ++/ ions of 600 keV leads to a narrower orientation distribution of the [111] direction of the Au layers from 12/sup 0/ FWHM to 6/sup 0/ and to only very small FWHM changes in texture distributions of the NbN layers. But the FWHM of the reflex distribution of the irradiated NbN layers is increased significantly from ΔΘ = 0.65/sup 0/ to 1.17/sup 0/ for one sample position. This is caused by small atomic dislocations in the NbN lattice. The FWHM of reflex distribution of the Au layers increased only from ΔΘ = 0.60/sup 0/ to 0.65/sup 0/ after irradiation. Oblique incidence of Ar/sup ++/ ions causes, by absence of channeling, stronger distortions than perpendicular incidence.

51604 **(LA-UR—88-2521) Recent results and continued development of the MTS [mechanical threshold stress] model.** Follansbee, P.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 28p. (CONF-8805161—2). NTIS, PC A03/MF A01. Order Number DE88016223/JAW.

From Workshop on dynamic constitutive/failure models for use in computer codes; Dayton, OH, USA (9 May 1988).

A review is given of the development of the Mechanical Threshold Stress (MTS) Model as a description of deformation in metals, particularly at high strain rates. The model is based on the use of internal state variables to represent the current structure or state of the material, and equations are written for the variation of the yield stress with strain rate and temperature and for the evolution of the state variables with strain, strain rate and temperature. The deformation behavior of several metals has been analyzed using this approach, and the results of these investigations are summarized. Work to extend the model to include the effects of deformation twinning and multiple strengthening mechanisms is described. 25 refs., 6 figs., 2 tabs.

51605 **(LBL—25254) Mechanical properties of high-strength aluminum alloys at cryogenic temperatures.** Morris, J.W. Jr.; Glazer, J. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 20p. (CONF-880653—4). NTIS, PC A03/MF A01. Order Number DE88016122/JAW.

From International conference on cryogenic materials applications and properties; Shenyang, China (7 Jun 1988).

This paper reviews the cryogenic mechanical behavior of high-strength aluminum alloys and describes some of the potential applications of these alloys at cryogenic temperatures. The aluminum alloys are unusual in that their mechanical properties often improve with decreasing temperature. The mechanical property data is summarized and briefly compared to that for other fcc materials, such as austenitic steels and nickel-based alloys, many of which also have better mechanical properties at low temperature. The cryogenic properties of aluminum alloys are discussed and interpreted in light of the current mechanistic theories of the influence of temperature on mechanical behavior. The discussion emphasizes the behavior of advanced aluminum-lithium alloys, which have exceptional mechanical properties at cryogenic temperature. 35 refs., 7 figs.

51606 **(LBL—25741) Tensile and shear behavior of alloyed Sn-Pb solder joints.** Quan, L.K. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016661/JAW.

This study presents an investigation of three ternary additions to a near-eutectic Sn-Pb alloy: indium (In), bismuth (Bi), and antimony (Sb). The effects of these ternary additions on the microstructure and on the strength in tensile and shear loading conditions in a joint configuration were studied. 17 refs., 29 figs.

51607 (MMIJ—8801, pp 505-506) **Separation and collection of vanadium from heavy oil combustion boiler slag.** Mukawa, Nobuaki. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Soda roasting is used as an industrial method for extracting vanadium (V) from boiler slag. Since this method consumes much energy, there is demand for developing a more economical extraction method. An extraction method using a sodium hydroxide solution was studied. A NaOH solution was added to slag; the mixture was heated and agitated, then filtered; the filtrate was analyzed. The V extraction rate was highest when the heating temperature was 120°C and the heating time was 120 minutes. The extraction temperature may be ordinary. When the extraction time was 15 minutes, the extraction rate was as high as 99.2%. The solid-liquid density has almost no bearing on the V extraction rate. When NH_4Cl was added to the extract and the mixture was agitated for 60 minutes, then left at rest, the V separation rate was 96% if the NH_4Cl concentration was 100 g/l and was zero if the concentration was 10 g/l or less. If ethanol was added, the V separation rate rose rapidly until the addition ratio became close to 1 and reached 99% when the addition ratio was 4 or 6. (4 figs, 1 tab)

51608 (NKSZ—8601, pp 291-305) **Study of energy storage material utilizing the superelasticity effect.** Otsuka, Kazuhiro; Shimizu, Ken'ichi; Miyazaki, Shuichi; Sakamoto, Hidekazu. (Univ. of Tsukuba, Inst. of Materials Sci., Ibaragi, Japan;Osaka Univ., The Inst. of Scientific and Industrial Research, Osaka, Japan). 30 Aug 1986. (In Japanese). Nissan Kagaku Shinko Zaidan, 6-17-2, Ginza, Chuo-ku, Tokyo.

In Research Project in review 1985 of Nissan Science Foundation.

For superelastic materials, the analysis of the crystal structure of the martensitic phase of a single-crystal specimen, crystallographical study of stress-induced martensitic transformation of a single-crystal speciment, improvement of superelastic characteristics through thermo-mechanical treatment, microscopic investigation of the causes of the superelastic characteristics due to thermo-mechanical treatment, and the effect of repeated deformation on super-elastic characteristics were investigated. The single-crystal specimen was Ni alloy containing Ti at 49.2% atom obtained through strain annealing. The results of structural analysis agree with Michal and Sinclair's report. It was found that the superelastic characteristics are remarkably improved when the ageing temperature is 673K. It has also been revealed that combination of ageing and various types of thermo-mechanical treatment helps the material exhibit very stable superelastic characteristics. (15 figs, 7 tabs, 35 refs)

51609 **(NRCN(TN)—049) Dilatometric measurements in an adjusted uranium alloy.** Zahavi, A.; Sariel, J.; Elgat, Z.; Kimmel, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Mar 1988. 23p. (In Hebrew). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703464/JAW.

Longitudinal and transverse specimens of cast adjusted uranium were tested in dilatometry. The specimens were as cast (ac), heat treated for 20 min. at 750/sup 0/c and water quenched (wq) and after subsequent treatment at 550/sup 0/c (ft). The measurements were used for several aims: a. Determination of the phase transformation temperatures. It was found that: at heating $\alpha \rightarrow \beta$ transformation at 654-659/sup 0/c $\beta \rightarrow \gamma$ transformation at 748-755/sup 0/c $\gamma \rightarrow \beta$ transformation at 727-734/sup 0/c $\beta \rightarrow \alpha$ transformation at 622-628/sup 0/c b. Determination of the thermal expansion coefficient. For the fully heat treated specimens (ft) the values of α = 23.34x10/sup -6///sup 0/c and 22.78x10/sup -6///sup 0/c were found for the longitudinal and transverse directions, respectively. Heat treated U-0.1%Cr specimen that was tested for comparison showed a value of α = 19.10x10/sup -6///sup 0/c c. Thermal cycling at the range between room temperature and 500/sup 0/c, as an indication for preferred orientation, and a simulation for radiation damage. It was found that all the specimens underwent length changes (usually contraction), but only the fully heat-treated specimens showed monotonic changes with the cycles. d. Examination of the difference between the heating and the cooling parts of the cycle, as an indication for the inner stress level. It was found that the fully heat-treated specimens had the lowest inner stress levels. (Auth.).

51610 **(NUREG/CR—4880-Vol.1) Characterization of irradiated current-practice welds and A533 grade B class 1 plate for nuclear pressure vessel service.** McGowan, J.J.; Nanstad, R.K.; Thoms, K.R. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 149p. (ORNL—6484/V1). NTIS, PC A07/MF A01 - GPO. Order Number TI88015471/JAW.

Studies of the effects of neutron irradiation on fracture toughness properties of steels have generally included a minimum number of tests for each material condition. The present study attempts to apply statistical analyses, with multiple testing at selected temperatures, to assess the accuracy and reliability of the results. Fracture toughness test specimens were irradiated in the Bulk Shielding Reactor at Oak Ridge National Laboratory at 288{degree}C to target neutron fluences of 2 {times} 10^{23} neutrons/m^2 (>1 MeV). The materials were ASTM A533 grade B class 1 plate (HSST Plate 02) and four submerged-arc welds representing the current fabrication practice for nuclear pressure vessels. Both unirradiated and irradiated specimens were tested by two separate laboratories, and multiple tests were conducted at selected temperatures. Statistical analyses permitted the determination of material and test variability and an interlaboratory comparison. Behavior in both the transition and ductile-shelf regions was studied. The results demonstrated the relatively low radiation sensitivity of low copper/nickel welds and the qualitative agreement between Charpy impact and fracture toughness observations of toughness degradation.

51611 **(ORNL/TM—10468) Analysis of adhesion test methods and the evaluation of their use for ion-beam-mixed metal/ceramic systems.** Pawel, J.E. (Oak Ridge National Lab., TN (USA); USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). Jul 1988. Contract AC05-84OR21400. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88015358/JAW.

Several thin film adhesion tests have been examined to determine which provides the most reliable method for the measurement of the adhesion of thin metallic films to ceramic substrate. An attempt was made to use the testing techniques described to measure adhesion changes caused by ion beam mixing for a variety of metal/ceramic systems. The techniques analyzed were the scratch

test, the acoustic-emission test, and the pull test. The major variables of the scratch test include film thickness, substrate hardness, and stylus radius, but it is not known precisely what effects changes in these have on the measurement of adhesion. The scratch analyses methods discussed in the literature, each describing a load or stress on the system that is presumed to cause de-adhesion, do not always hold because none of the analyses account for both plastic and elastic deformation or incorporate many of the important parameters. The scratch test was much more likely to reveal a critical value for de-adhesion for relatively brittle films such as chromium than for ductile films such as nickel. 65 refs, 29 figs, 17 tabs.

51612 **(PB—88-866942/XAB) Optical coatings: laser radiation damage. January 1975-July 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 80p. NTIS PC N01/MF N01.

Supersedes PB—87-864757.

This bibliography contains citations concerning theoretical aspects and experimental investigations of laser-induced damage of optical coatings. Damage thresholds of metal, dielectric, and metal-dielectric coating materials used in high-power lasers are discussed. The origin and morphology of damage, and the effects of coating processes and materials, and substrate materials on laser damage are included. Laser sources are also considered. (This updated bibliography contains 142 citations, 11 of which are new entries to the previous edition.)

51613 **(PNL-SA—15258) Neutron irradiation in ferritic Fe-Cr alloys.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 35p. (CONF-880613—18). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014758/JAW.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Work on microstructure in ferritic alloys following irradiation in FFTF is presented: Fe-Cr binary alloys ranging from 3 to 18 Cr, and substitutional ferritic alloys based on Fe-10Cr with minor additions of Si, Mn, V, Ta, and Zr. Irradiations were performed to fluences as high as 30 dpa at 425{degree}C. The simple Fe-Cr binary alloy behavior following irradiation to 15 dpa was similar to that observed following irradiation in EBR-II. All specimens contained radiation damage such as dislocation loops and voids. Swelling was highest, 0.26%, in the Fe-9Cr alloy with a corresponding dislocation network comprising equal parts of a<100> and a/2 <111> Burgers vectors. Less swelling was found in other alloys with a corresponding dislocation structure composed mainly of a<100> loops. A deformation slip band containing elongated voids indicated that channel fracture may occur in ferritic alloys that contain uniform void swelling. The behavior of substantial Fe-10Cr ferritic alloys following irradiation to 30 dpa demonstrated that different solutes affect microstructural development. Void and dislocation development were observed in all conditions but the amount of swelling and the dislocation character (a<100> versus a/2 <111>) and structure (network versus individual loops) varied both with solute type and amount of solute (0.1 or 1.0 wt %). Swelling was lowest in Fe-10Cr-1Si due to delayed void nucleation; the dislocation structures were loop dominated in both Fe-10Cr-1Si and Fe-10Cr-1V. Void shape was found to vary between dodecahedral with {011} faces and {100} truncations and cubic with {100} faces and {011} truncations. 26 refs., 21 figs., 4 tabs.

51614 **(PPA-T—72) Effect of heat treatment on carbon steel pipe welds.** Mohamad Harun. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). [1987]. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703468/JAW.

The heat treatment to improve the altered properties of carbon steel pipe welds is described. Pipe critical components in oil, gasification and nuclear reactor plants require adequate room temperature toughness and high strength at both room and moderately elevated temperatures. Microstructure and microhardness across the welds were changed markedly by the welding process and heat treatment. The presentation of hardness fluctuation in the welds can produce premature failure. A number of heat treatments are suggested to improve the properties of the welds. (author) 8 figs., 5 refs.

51615 **(PSI—7) Corrosion behaviour of unalloyed steel in Portland cement.** Grauer, R. (Paul Scherrer Institut, Wuerenlingen (Switzerland)). (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland). Programm Entsorgung). Apr 1988. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703940/JAW.

The production of hydrogen can cause problems in a repository for low and intermediate level waste. Since the production of gas is mainly due to the corrosion of unalloyed steel, it is important to have as reliable data as possible for the corrosion rate in anaerobic cement. A review of the literature shows that the corrosion current densities are in the range of 0.01 to 0.1 μA/cm/sup 2/ (corresponding to corrosion rates between 0.1 and 1.2 μm/a). This implies hydrogen production rates between 0.022 and 0.22 mol/(m/sup 2/a). Corrosion rates of the abovementioned order of magnitude are technically irrelevant, so that there is little interest in determining them accurately. Furthermore, their determination entails problems of measurement technique. In the present situation it would therefore appear risky to accept the lower value as proven. Experiments are proposed to reduce the present uncertainty. (author) 35 refs., 10 figs.

51616 **(RFP—4246) Fatigue and strain hardening of simulated case microstructure in carburized steels.** Zaccone, M.A.; Krauss, G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Colorado School of Mines, Golden (USA). Dept. of Metallurgial Engineering). 1988. Contract AC04-76DP03533. 6p. (CONF-8809113—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014933/JAW.

From 6. international conference on heat treatment of materials; Chicago, IL, USA (28 Sep 1988).

Tension, compression, and cyclic stress-strain testing were used to evaluate the effect of retained austenite on high and low cycle fatigue of Cr-Mo-Ni alloy steels containing 0.8 pct C to simulate the high carbon case of carburized steels. In low cycle fatigue, cracks develop at austenite grain boundaries early during tensile and cyclic loading. Propagation of these cracks is stabilized in specimens which contain large amounts of retained austenite which dynamically forms martensite by strain-induced transformation. Without sufficient austenite, incipient cracks are not effectively stabilized, and low cycle fatigue life is reduced. In high cycle fatigue, insufficient strain accumulates for the activation of strain-induced martensite, and large amounts of retained austenite are not as beneficial as in low cycle fatigue. Microstructures with 30--35 volume percent retained austenite and fine mixtures of martensite and austenite which contribute to high elastic limits appear to be the most satisfactory for good high and low cycle fatigue resistance. 18 refs., 6 figs., 4 tabs.

51617 **(RFP—4263) Reaction kinetics for the high temperature oxidation of Pu--1wt%Ga in water vapor.** Stakebake, J.L.; Saba, M.A. (Rockwell International Corp., Golden, CO (USA)). 1988. Contract AC04-76DP03533. 3p. (CONF-881168—1). NTIS, PC A02/MF A01. Order Number DE88014934/JAW.

From DOE compatability meeting and Mound Labs and DOE surface conference; Largo, FL, USA (1 Nov 1988).

Oxidation of plutonium metal is greatly accelerated by the presence of water vapor. The magnitude of the effect of water vapor on oxidation kinetics is determined by temperature, water concentration, and oxygen concentration. Most of the previous work has been directed toward evaluating the effect of moisture on the atmospheric oxidation of plutonium. Work on the isolation and characterization of the water reaction with plutonium has been very limited. The present work was undertaken to determine the kinetics of the plutonium--water reaction over a wide range of temperature and pressure. Reaction kinetics were measured using a vacuum microbalance system. The temperature range investigated was 100--500{degree}C. The effect of water vapor pressure on reaction kinetics was determined at 300{degree}C by varying the water pressure from 0.1 to 15 Torr. 2 figs.

51618 **(UCID—21450) Effects of grain strain and strain rate on the flow stress of copper.** Lassila, D.H. (Lawrence Livermore National Lab., CA (USA)). 17 Feb 1988. Contract W-7405-ENG-48. 6p. NTIS, PC A02. Order Number DE88016112/JAW.

A study was performed to determine the effects of grain size and deformation rate on the flow stress of OFE copper. Testing was performed in compression at ambient conditions at quasi-static and high strain rates. Testing at different strain rates allowed the dependence of the Hall-Petch parameters on strain rate to be examined. The effect of various crystallographic textures on mechanical behavior was also examined. Findings of the study are as follows: Decrease in grain size caused an increase in flow stress. The observed dependence of flow stress on grain size was found to be consistent with the Hall-Petch relation. Results of the study suggest that strain rate does not have an influence on the proportional relationship between flow stress and grain size, i.e., the Hall-Petch parameter $k\epsilon$ is not strain-rate dependent. Crystallographic texture had no discernible effect on stress-strain response at high strain rates.

51619 **(UCRL—97716) Nucleation and growth in surface melted alloys.** Kaufmann, E.N.; Huang, J.S.; Karo, A.M.; Wall, M.A.; DeBoni, T.M. (Lawrence Livermore National Lab., CA (USA)). Jul 1988. Contract W-7405-ENG-48. 12p. (CONF-880529—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015443/JAW.

From MRS international meeting on advanced materials; Tokyo, Japan (30 May 1988).

Rapid surface melting and solidification data is presented and a microscopic simulation is described. Examples are Cr-Ta, FeNiPB metallic glass, Ta-Ir, Cu-Z. 9 figs., 9 refs.

51620 **Electromotive force measurements in liquid K—Te solutions with a potassium β alumina electrolyte.** Petric, A.; Pelton, A.D.; Saboungi, M. (Ecole Polytechnique, Campus de l'Universite de Montreal, C. P. 6079, Succ. "A", Montreal, Quebec H3C 3A7, Canada). *Journal of Chemical Physics;* **89**: No. 8, 5070-5077(15 Oct 1988).

Thermodynamic properties and phase relations of K—Te alloys were measured over a temperature range of 573—873 K and over the composition range 0—55 at. % K. An electromotive force (emf) technique was used in which potassium-substituted beta alumina served as the solid electrolyte. Partial and integral values of Gibbs energy, entropy, enthalpy, excess stability, and excess heat capacity are reported. The excess stability function exhibits maxima near 12 and 50 at. % K which can be interpreted as an indication of maximum short-range ordering near these compositions. Liquidus points on the phase diagram are also reported as are the Gibbs energies of formation of the compounds K_2Te_3 and KTe.

51621 **Measurements of 3d state occupancy in transition metals using electron energy loss spectrometry.** Pearson, D.H.; Fultz, B.; Ahn, C.C. (Division of Engineering and Applied Science 138-78, California Institute of Technology, Pasadena, California 91125). *Applied Physics Letters;* **53**: No. 15, 1405-1407(10 Oct 1988).

We report a linear correlation between ·he total intensities of the L/sub 2,3/ white lines in electron energy loss spectra and the number of unoccupied 3d states in 3d transition metals. We show that this correlation can be used to obtain quantitative information about electronic changes during alloying and during solid-state phase transformations.

51622 **Quantum-well states in a metallic system: Ag on Au(111).** Miller, T.; Samsavar, A.; Franklin, G.E.; Chiang, T. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review Letters;* **61**: No. 12, 1404-1407(19 Sep 1988).

Quantum-well states have been observed with angle-resolved photoemission for Ag overlayers with thicknesses up to 40 monolayers epitaxially grown on Au(111). These states are observed within an energy window of 1 eV. The complementary system, Au on Ag(111), exhibits no such states. The results can be explained in terms of the band-structure mismatch between Au and Ag. The coherence length of the states and quasibound quantum-well resonances will be discussed.

51623 **Theoretical study of the electronic structure of ordered and disordered Cu_3Au.** Weinberger, P.; Boring, A.M.; Albers, R.C.; Temmerman, W.M. (Institut fuer Technische Elektrochemie, Technical University Vienna, Austria). *Physical Review [Section] B: Condensed Matter;* **38**: No. 8, 5357-5362(15 Sep 1988).

The electronic structure of the ordered phase of Cu_3Au is investigated using the self-consistent-field (SCF) fully relativistic linear-muffin-tin-orbital method. The electronic structure of the disordered phase is obtained from a fully relativistic Korringa-Kohn-Rostoker coherent-potential-approximation calculation. To show the effects of self-consistency in the disordered phase, we present both non-SCF and SCF results for this phase. These results show that the largest changes in the electronic structure upon ordering are in energy regions away from the Fermi energy. To verify this prediction we have calculated the x-ray-photoemission (XPS) intensities for both phases and compared these to experimental data. It is found that the calculated Al Kα XPS intensity is in excellent agreement with the data on the ordered system and gives a clear picture of the itinerant nature of the Au 5d states. For the disordered state our results are in agreement with trends seen in angle-resolved photoemission, but are in disagreement with the only angle-integrated XPS data available on the disordered system.

51624 **Effect of simultaneous heavy-ion and electron bombardment on the amorphization kinetics of intermetallics.** Pedraza, D.F. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6376). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 4803-4809(1 Sep 1988).

A theory of amorphization of ordered intermetallic compounds is applied to the case of simultaneous irradiation by electrons and heavy ions. The theory proposes that the local buildup of radiation-induced defects (interstitial-vacancy complexes) to a critical value destabilizes the crystalline lattice in a small region, causing it to become amorphous. The rate of increase of the complex concentration results from a balance between complex formation (with an athermal component under ion bombardment) and complex annihilation by thermally activated processes. This mechanism explains, in the case of electron irradiation, the existence of a cutoff temperature, T/sub e//sup c/, above which no crystalline-to-amorphous transition occurs due to insufficient complex buildup. In the case of ion bombardment, a cutoff temperature, T/sub i//sup c/, is also obtained, above which no significant complex accumulation takes place, but T/sub i//sup c/ is higher than T/sub e//sup c/. It is shown that simultaneous bombardment with ions and electrons leads to an acceleration of the transition up to temperatures around T/sub e//sup c/ and to a progressive delay and possible suppression of the transition at increasing irradiation temperatures between T/sub e//sup c/ and T/sub i//sup c/. .AE

51625 **Neutron scattering study of spin fluctuations in Y(Mn/sub 1-//sub x/Al/sub x/)$_2$.** Motoya, K.; Freltoft, T.; Boeni, P.; Shirane, G. (Department of Physics, Faculty of Science, Saitama University, 255 Shimo-Okubo, Urawa, Saitama 338, Japan). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 4796-4802(1 Sep 1988).

Elastic and inelastic neutron-scattering measurements have been made on a series of pseudobinary intermetallic compounds Y(Mn/sub 1-//sub x/Al/sub x/)$_2$. Long-range antiferromagnetic order below T/sub N/$\sim$100 K in YMn_2 has been shown to collapse by substitution of only 5% of the manganese atoms by aluminum atoms. In these compounds, a spin-glass transition has been clearly indicated by a change in the energy width of the scattered-neutron spectrum, as well as by the onset of field hysteresis in susceptibility measurements. In the compound with $x = 0.10$, the amplitude of spin fluctuations S does not change appreciably with temperature, whereas in YMn_2 it drops by more than 30% at T/sub N/ and then increases gradually with increasing temperature. A considerable degree of spatial correlations of spin fluctuations persists up to at least 760 K, which is similar to the behavior observed

in YMn_3 but quite different from the characteristics of simple localized-electron magnets.

51626 Channeling measurement of solute vibration amplitude in an alloy. Barrett, J.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 5069-5072(1 Sep 1988).

Computer simulations are used to show how measurements of ion channeling may be very sensitive to differences in thermal vibration amplitude between solute and host atoms in an alloy. Application is made to the measurements of Alexander and Poate on an alloy of ~2 at. % Au in Cu, and it is concluded that the vibration amplitude of Au is 86% as large therein as that of Cu.

51627 Procedure for flaw detection in cast stainless steel. Kupperman, D.S. (to Dept. of Energy, Washington, DC). US Patent 4,760,737. 2 Aug 1988. Filed date 29 Aug 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method of detecting flaws in the wall of a tubular metal component in which the microstructure of the metal of the component may vary at different locations on the metal component from elastically isotropic with equiaxed grains to elastically anisotropic with columnar grains and further in which there is ultrasonic flaw detection means each of which alternately provide the most effective result as applied to the different microstructures of the metal is described comprising: determining at one location on the component the nature of the microstructure of the metal by an ultrasonic method; inspecting the tubular metal component at the one location for flaws with the one ultrasonic flaw detection means of the plurality of ultrasonic flow detection means which provides the most effective result based upon the microstructure so determined whereby the component can be inspected for flaws at a particular location.

51628 Electrodeposition of cadmium from aqueous fluoborate electrolytes. Varma, R.; Shimotake, H.; Hoeller, T.L.; Agarwala, V. (Argonne National Lab., Argonne, IL (US)). *Materials Performance;* **27**: No. 5, 39-44(May 1988).

A new method of electroplating cadmium on high-strength steel from aqueous fluoborate electrolytes has been developed at Argonne National Laboratory. The cadmium coatings are fine grained, coherent, and strongly adherent to the substrate. With this method, a high-rate electrodeposition is achieved in an electrolyte flow cell using an optimized pulse nucleation step followed by deposit growth under a DC or pulsed current. This method minimizes the steel embrittlement that results from hydrogen codeposition during plating.

51629 Microstructure of Ni/sub 3/Al ingots containing boron. Zinoviev, V.; Schulson, E.M.; Baker, I. (Burndy Corp., Norwalk, CT (US)). *Metallography;* **21**: No. 2, 207-216(May 1988).

The microstructures of nominally stoichiometric ingots of Ni/sub 3/Al with boron contents up to 1.12 at.% were examined in the as-received and in the homogenized states. A second phase was observed in the ingot containing 1.12 at% boron. The effect of homogenization on this phase is described.

51630 The effect of the precipitate size distribution on the aging curve of order hardening alloys. Glazer, J.; Morris, J.W. Jr. (Dept. of Materials Science and Mineral Engineering, Univ. of California, Berkeley and Center for Advanced Materials, Lawrence Berkeley Lab., Berkeley, CA (US)). *Acta Metallurgica;* **36**: No. 4, 907-915(Apr 1988).

The effect of the shape of the precipitate size distribution on the age-hardening behavior of alloys strengthened by ordered precipitates is investigated using a modified version of the Hanson and Morris strong line model for the critical resolved shear stress. This model accounts for the influence of dislocations self-interactions on the effective strength of obstacles to dislocation glide. The model predicts that the largest precipitates are responsible for the peak in strength, but that the value of the peak strength is determined principally by the average precipitate radius at peak strength. The peak strength for a given volume fraction is maximized if all of the precipitates are the same size. These qualitative results are used to interpret existing data on the effect of the precipitate size distribution. The contributions of obstacles of differing strengths are included through a quadratic sum rule. Binary aluminum-lithium alloys are used as a model system with which to examine the quantitative accuracy of the model.

51631 Martensitic transformation induced by a tensile stress pulse in Fe-22.5 wt% Ni-4 wt% Mn alloy. (Dept. of Applied Mechanics and Engineering Science, Univ. of California at San Diego, La Jolla, CA (US)). *Acta Metallurgica;* **36**: No. 4, 1085-1098(Apr 1988).

The kinetics of martensitic transformation induced by a tensile pulse, produced by shock-wave reflection at the rear free surfaces of both projectile and target, has been investigated. The tensile stress thus generated prevails in time durations of microseconds and fractions thereof, ad produces a considerable increase in the magnitude of the driving force for the $\gamma \rightarrow$ chi' martensitic transformation. This technique allows the determination of kinetic and thermodynamic parameters (driving forces and activation energies for transformation) in regimes not attainable by conventional techniques. The alloy chosen for this investigation (Fe-22.5 wt% Ni-4 wt% Mn) exhibits a very sluggish isothermal transformation. It was found that the volume fraction of martensite transformed at a constant impact pressure increased with increasing pulse duration at a constant temperature, and with decreasing temperature (-60 to -177°C) at a constant pulse duration. The C-curve kinetic behavior that is typical of isothermal martensitic transformations was not observed. From the results obtained, the isothermal kinetics and energetics of the transformation were obtained and interpreted in terms of the existing theories. The activation volume for nucleation was equal to 65 atomic volumes. The morphology of martensite under zero stress consists of many fragmented plates of the same orientation, while the martensite transformed under impact conditions was more often lenticular. Transmission electron microscopy and diffraction analysis were made on martensite induced by the tensile pulse technique, and the martensite habit plane was found to be (112).

51632 The effect of boron on the lattice properties of Ni/sub 3/Al. Baker, I.; Huang, B.; Schulson, E.M. (Thayer School of Engineering, Dartmouth College, Hanover, NH (US)). *Acta Metallurgica;* **36**: No. 3, 493(Mar 1988).

Lattice parameter measurements have shown that boron is soluble in stoichiometric Ni/sub 3/Al up to at least 1.12 at.% and that it produces a lattice strain (Δa Δc x 1/a/sub 0/) of 0.13. Compression testing of large-grained stoichiometric Ni/sub 3/Al alloys doped with different amounts of boron has indicated a large lattice strengthening effect of 387 MPa per at.%. Transmission electron microscope observations revealed that boron concentrations above a certain level (in the range >0.38 at.% but <0.75 at.%) prevent superlattice-intrinsic stacking fault (S-ISF) formation. However, no accompanying change in work-hardening rate (5050MPa) was found, indicating that S-ISF's contribute little resistance to plastic flow. The large change in strength per fractional change in lattice parameter due to boron additions (3.76G) compared to other B-subgroup elements (0.27G) suggests that boron produces an asymmetric strain field.

51633 Surface and grain boundary segregation of sulfur and boron in nickel. Ladna, B.; Birnbaum, H.K. (Dept. of Materials Science and Engineering, Univ. of Illinois at Urbana-Champaign, 1304 W. Green Street, Urbana, IL (US)). *Acta Metallurgica;* **36**: No. 3, 745-766(Mar 1988).

Auger electron spectroscopy and secondary-ion-mass spectrometry was used to study surface and grain boundary segregation of B and S in Ni. Sulfur segregation was not influenced by the presence of boron and resulted in a uniform monolayer surface and grain boundary coverage. Segregation of boron differed from that of sulfur and resulted in the precipitation of Ni/sub 3/B in the near surface layer. Borides dissolved into the matrix at temperatures above 923 K and precipitated during cooling. This process did not affect the segregation of sulfur, which covered the borides and matrix uniformly. Grain boundary segregation of boron, its effect on the co-segregation of sulfur and the tendency for intergranular

fracture were studied using hydrogen charged fractured samples. Addition of boron reduced the tendency for intergranular fracture. A small amount of boron was found at the grain boundaries, together with sulfur and carbon; the sulfur and carbon levels were about 20% smaller than in the boron-free sample. The results suggest that boron has a beneficial effect on the strength of the grain boundaries and also reduces the negative effect of sulfur segregation.

51634 **As-quenched Cu-10.9 at.% Be.** Koo, Y.M.; Cohen, J.B.; Shapiro, S.M.; Tanner, L.E. (Dept. of Materials Science and Engineering, The Technological Institute, Northwestern Univ., Evanston, IL (US)). *Acta Metallurgica;* **36**: No. 3, 591(Mar 1988).

Diffuse X-ray scattering, elastic and inelastic neutron scattering were examined to investigate the local atomic structure, static strains and phonon dispersion in a single crystal of a Cu-10.9 at.% Be in the as-quenched state. There is a nearly regular array of small ellipsoidal Be-clusters aligned along <1 1 0> directions. (This array produces the tweed structure seen in TEM.) The density of these cluster is 7.5 x 10/sup 26/ m/sup -3/. The <h h 0> diffuse streaks seen in electron diffraction patterns are due mostly to thermal diffuse scattering. The phonon dispersion curves have no large differences from those of pure Cu except at the [zeta zeta zeta]/sub T/ zone boundary where there is softening. This difference may be due to a Kohn anomaly. The elastic anisotropy increases with alloying, which probably leads to the plate-like GP zone morphology in subsequent aging treatments.

51635 **Cascade defect production and irradiation enhanced diffusion in Cu/sub 3/Au.** Kirk, M.A.; Funk, L.L. (Materials Science Div., Argonne National Lab., Argonne, IL (US)). pp 38-47 of Radiation-induced changes in microstructure: ASTM 13th international symposium (Part I). Garner, F.A.; Packan, N.H.; Kumar, A.S. Philadelphia, PA; ASTM (1987). (CONF-860605—).

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

By using the ordering alloy Cu/sub 3/Au and measuring resistivity changes during and following fast-neutron irradiations under well-controlled conditions in the Radiation Effects Facility at the Intense Pulsed Neutron Source at Argonne National Laboratory, the authors studied cascade defect production ad irradiation enhanced diffusion between 10 and 460 K. Ordering and disordering rates were measured as functions of irradiation temperature, neutron dose, neutron dose rate, time following cessation of flux, and step annealing. Free and clustered vacancy production was observed. The temperature dependence of the production of total migrating vacancy concentrations was determined. Vacancy sink production was linear with neutron dose and is compared with recent transmission electron microscopy experiments on the production of dislocation loops in this alloy. Time dependent and quasi-steady vacancy considerations were measured and compared with solutions of reaction rate equations for irradiation enhanced diffusion. The influence of recombination vacancies with interstitials is observed to low sink concentrations (low neutron doses).

51636 **Processing technology for nickel aluminides.** Sikka, V.K. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 487-494 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Ductile ordered intermetallic alloys of nickel aluminum or nickel aluminum chromium have been developed at the Oak Ridge National Laboratory (ORNL) by optimized additions of boron. These alloys show excellent elevated temperature mechanical properties and corrosion properties. However, in order for the alloys to find use in various applications, they should be fabricable by either the well established or innovative processing technologies. The present paper will discuss the details of fabrication technology being pursued at ORNL. The processes being investigated include powder consolidation by extrusion, powder consolidation by capping, isothermal forging of powder compacted material, twin-roller casting to thin sheet followed by cold-rolling, direct casting rod from liquid, extrusion of billets made by argon-induction melting and electroslag remelting processes, injection molding of powders, and hot isostatic pressing of powders. Relative merits of each process are discussed. Mechanical properties data on products made by various processes are also presented and compared.

51637 **Annealing of cold worked hypostoichiometric Ni/sub 3/Al alloys using positron lifetime spectroscopy.** Usmar, S.G.; Lynn, K.G. (Brookhaven National Lab., Dept. of Metallurgy and Materials Science, Upton, NY (US)). pp 111-116 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Hypostoichiometric Ni/sub 3/Al alloys of composition 76.2 Ni:23.8 Al containing impurity levels of boron and hafnium (supplied by Oak Ridge National Laboratory) were either cold rolled or pressed. Rolled and pressed samples were deformed by 20% and 10% thickness reductions, respectively. Samples were annealed isochronally at approximately 50°C intervals up to 1050°C. Two major annealing stages were apparent in all three alloys studied. These could be attributed to vacancy migration to sinks and annealing of dislocations and(or) recrystallization. The onset of vacancy migration occurred at approximately 200°C in all three alloys. Annealing of dislocations started at 650°C to 700°C and was complete at 1000°C for alloys which contained boron and or hafnium impurities. In the pure alloy the onset of dislocation annealing occurred at 800°C and was incomplete at the highest (1050°C) annealing temperatures reached.

51638 **Site occupation determinations in Ni/sub 3/Al by atom probe.** Miller, M.K.; Horton, J.A. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 117-122 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The site occupation of three substitutional elements, hafnium, iron and cobalt, in substoichiometric Ni/sub 3/Al was determined from atom probe filed-ion microscopy. The hafnium was found to have a strong preference for the aluminum sites, the cobalt had a strong preference for the nickel sites, and the iron had a weak preference for the aluminum sites. The atom probe results were in agreement with zone axis electron channeling microanalysis of the same alloys and predictions from the position of the solubility lobes in the ternary phase diagrams.

51639 **Ab initio theory of the ground state properties of ordered and disordered alloys and the theory of ordering processes in alloys.** Stocks, G.M.; Nicholson, D.M.; Pinski, F.J.; Butler, W.H.; Sterne, P.; Temmerman, W.M.; Gyorffy, B.L.; Johnson, D.D.; Gonis, A.; Zhang, X.G. (Oak Ridge Lab., P.O. Box X, Oak Ridge, TN (US)). pp 15-26 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors review some of the advances in the calculation of the electronic structure and energetics of ordered and disordered alloys that hold out the possibility of obtaining, in the not-too-distant future, an ab initio theory of ordering and phase stability in alloys. In particular, they focus on the calculation of the ground state properties of Ni/sub 3/Al and discuss the competition between the L1/sub 2/ and DO/sub 22/ ordered structures. They review the ab initio concentration functional theory of ordering developed by Gyorffy and Stocks and its application to the short-range-ordered solid-solution state in Cu/sub c/Pd/sub 1-c/ alloys. Finally, the authors review the generalized perturbation method approach to calculation of multisite interchange potentials in Ni/sub 3/Al, Pd/sub 3/V, and Al/sub 3/Ti and again discuss L1/sub 2// DO/sub 22/ competition as well as antiphase boundary energies in Ni/sub 3/Al.

51640 Effective-pair-interactions from supercell total energy calculations: Al-transition metal alloys. Carlsson, A.E. (Washington Univ., St. Louis, MO (US)). pp 39-44 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Effective-pair-interactions (EPI) are computed for alloys of Al with transition metals, Li, and Zn, using a method in which concentration-independent cluster interactions are resummed to obtain the concentration-dependent EPI. The method includes alloy fluctuations in the interatomic charge transfer, enables one to transcend the muffin-tin approximation and thus treat surfaces and layered structures, and allows the inclusion of lattice strain effects. The calculated EPI have a large magnitude when d-bonding effects are important. For transition metals the EPI are strongly concentration-dependent. In NiAl, results for bcc and fcc lattices are similar and exhibit a quick decay of the EPI with interatomic separations. The concentration dependence of the transition metal EPI exhibits rapid oscillations with the number of valence electrons. The concentration-averaged EPI varies less dramatically. The oscillations in the concentration dependence of the EPI are interpreted in terms of the position of the Fermi level relative to peaks and valleys in the one-electron density of states.

51641 Atomistic simulations of [001] symmetric tilt boundaries in Ni/sub 3/Al. Chen, S.P.; Voter, A.F.; Srolovitz, D.J. (Los Alamos National Lab., Los Alamos, NM (US)). pp 45-50 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors report a systematic atomistic simulation study of [001] symmetric tilt grain boundaries (GB) in Ni/sub 3/Al, Ni, and Al. The authors found that the grain boundary energies and cohesive energies of Ni/sub 3/Al and pure fcc Ni are approximately the same. Grain boundary energies and cohesive energies in Ni/sub 3/Al depends strongly on the grain boundary composition. The Al-rich boundaries have highest grain boundary energies and lowest cohesive energies. This offers an explanation for the stoichiometric effect on the boron ductilization.

51642 Calculation of the defect and interface properties of Ni/sub 3/Al. Foiles, S.M. (Sandia National Labs., Livermore, CA (US)). pp 51-56 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The structure and energetics of point defects, surfaces and grain boundaries in Ni/sub 3/Al are investigated using the Embedded Atom Method. The approach is shown to reproduced the experimental phase diagram of the Ni-Al system and the elastic properties of Ni/sub 3/Al. The vacancy and anti-site defect energies are calculated and used to predict the vacancy concentration as a function of bulk composition. The preferred geometries and energies of the low index surfaces are also computed. The equilibrium structure of certain ideal grain boundaries are computed by Monte Carlo computer simulations as a function of bulk composition. It is found that the boundaries act as a sink for anti-site defects and the degree of ordering at the boundaries is strongly affected by the bulk composition. The cohesive energy of grain boundaries in Ni/sub 3/Al is computed and is found to be comparable to that for pure Ni.

51643 Modeling of antiphase boundaries in L1/sub 2/ structures. Sanchez, J.M.; Eng, S.; Wu, Y.P.; Tien, J.K. (Center for Strategic Materials and Henry Krumb School of Mines, Columbia Univ., New York, NY (US)). pp 57-64 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The thermodynamic properties of conservative (111) antiphase boundaries in L1/sub 2/ ordered structures are modeled using the tetrahedron approximation of the cluster variation method. The concentration and long-range order parameter profiles are determined as a function of temperature and composition of the bulk alloy. Characteristic wetting transitions, with a macroscopic disordered layer growing from the antiphase boundary as the transition temperature is approached, are found for all cases investigated. The effect of antiphase boundaries on the disordering of ordered alloys and on the gliding of superdislocations are discussed.

51644 FIM / atom probe studies of B-doped and alloyed Ni/sub 3/Al. Sieloff, D.D.; Brenner, S.S.; Burke, M.G. (Univ. of Pittsburgh, Materials Science and Engineering Dept., Pittsburgh, PA (US)). pp 87-98 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Field-ion microscopy and atom probe microanalysis have been used to determine the structure and chemistry of grain boundaries in ductile, recrystallized Ni/sub 3/Al containing 0.23 at% B (500 wt. ppm). The results indicate that the boron concentration fluctuates along the boundary plane and that the boron enriched zone is wider than expected from equilbrium-type adsorption. It was also found that boron lowers the aluminum concentration of some of the boundary regions.

51645 Dislocation reactions at grain boundaries in L1/sub 2/ ordered alloys. King, A.H.; Yoo, M.H. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 99-104 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The characteristics of perfect grain boundary dislocations in ordered alloys are discussed, and consideration is given to the possible formation of perfect and imperfect grain boundary dislocations by the impingement of crystal lattice dislocations. It is shown that many dislocation reactions at grain boundaries in ordered alloys are made unfavorable if chemical co-ordination must be maintained in the structure of the grain boundary. This leads to a suggestion that the effect of boron in the grain boundaries of Ni/sub 3/Al is to reduce the importance of chemical ordering, and thus to promote deformation by allowing greater freedom for dislocation reactions to occur.

51646 Lattice location of boron and hafnium dopants in an ordered nickel aluminide by use of ion channeling/nuclear reaction analyses. Bohn, H.G.; Williams, J.M.; Barrett, J.H.; Liu, C.T. (Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 127-134 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Experiments have made use of Rutherford backscattering (RBS), ion channeling techniques and analyses for nuclear reaction products to study lattice location of B and Hf dopants in an ordered nickel aluminide. Studies were of an alloy single crystal of composition Ni/sub 76/Al/sub 23/Hf/sub 1/ with about 0.1 at.% of B added. Analysis for B was accomplished by detection of alpha particles resulting from the reaction /sup 11/B(p,α)/sup 8/Be, in ion channeling experiments in which RBS from the Ni constituent was used to control channeling in the host lattice. Yield of the reaction product from proton interaction with B decreased relative to random for channeling in a <100> direction, but increased relative to random for channeling in a <110> direction. It was concluded that B occupies primarily octahedral interstitial sites. RBS/channeling half-angles for Hf in a <100> direction are somewhat smaller than those for Ni, but nevertheless considerably larger than half-angles expected for Al. It is concluded that the majority of Hf atoms are on the Ni sublattice.

51647 **Grain boundary and surface segregation in boron doped Ni/sub 3/Al.** White, C.L.; Choudhury, A. (Dept. of Metallurgical Engineering, Michigan Technological Univ., Houghton, MI (US)). pp 427-441 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Grain boundary segregation, and its effects on strength and ductility, play an especially important role in the performance of intermetallic alloys based on Ni/sub 3/Al. The effect of a given segregant on grain boundary strength appears to be determined to some extent by its tendency to segregate to free surfaces. In this paper, the authors briefly review the available information on grain boundary and surface segregation in boron doped Ni/sub 3/Al.

51648 **An atom probe study of boron segregation to line and planar defects in Ni/sub 3/Al.** Horton, J.A.; Miller, M.K. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 105-110 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Atom probe analyses of rapidly solidified, boron-doped Ni-24 at % Al subjected to various heat treatments have shown boron segregation to a wide range of linear and planar defects. These include dislocations, superlattice intrinsic stacking faults, antiphase boundaries, twin boundaries, low-angle boundaries (dislocation cell walls), and high-angle boundaries. Boron coverage of these features was found to to vary along a particular linear or planar defect and from boundary to boundary.

51649 **The segregation of boron and its effect on the fracture of an Ni/sub 3/Si based alloy.** Oliver, W.C.; White, C.L. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 241-246 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

It is now well established that microalloying additions of B to Ni/sub 3/Al drastically reduce low temperature grain boundary fracture and consequently increase the ductility of this intermetallic compound. One possible explanation for such effects involves the relationship between boron segregation to grain boundaries and free surfaces, and the resulting effect of such segregation on the cohesive energy of the grain boundaries. This study involves the extension of these concepts to an alloy based on Ni/sub 3/Si. Auger spectroscopy has been carried out on fractured grain boundaries, grain interiors, and free surfaces to determine how B segregates in Ni/sub 3/(Si,Ti). The consequences of the segregation of B on the cohesive energy of grain boundaries in Ni/sub 3/Si based alloys are discussed.

51650 **Effects of elastic anisotropy on the anomalous yield behavior of cubic ordered alloys.** Yoo, M.H. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 207-212 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The positive temperature dependence of yield stress in certain L1/sub 2/ and B2 alloys, e.g. Ni/sub 3/Al and B′-CuZn, is analyzed on the basis of the nature of dislocation dissociations predicted by anisotropic elasticity theory. In the case of Ni/sub 3/Al, the torque due to the tangential component of the elastic interaction between two superpartials is a major driving force for either the cross-slip pinning model or the force couplet model. The corresponding torque term is relatively unimportant in the B2 structure. The core transformation of individual superpartials may be important for the anomalous increase of yield stress in B′-CuZn.

51651 **Creep cavitation in a nickel aluminide.** Schneibel, J.H.; Martinez, L. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 297-302 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A nickel aluminide with the composition Ni-23.5 Al-0.5 Hf-0.2 B (at.%) was creep-tested in tension at constant load (initial stress 250 MPa, temperature 1033 K). The creep rate reaches a minimum at a strain of approximately 0.3%. Its increase at larger strains is partly caused by grain boundary cavitation. Cavity size distributions corresponding to different creep times and strains were determined metallographically and evaluated in order to obtain the cavity growth rate as a function of cavity size. Contrary to a newly developed model for crack-like diffusive growth the cavity tip velocity increases with cavity size. This discrepancy is attributed to cavity coalescence. Sintering at elevated temperatures (1473 K) reduces the diameter and increases the thickness of the disc-shaped cavities. Sintering of such cavities might be exploited to measure surface diffusivities.

51652 **Dispersoids in intermetallic alloys: A review.** Koch, C.C. (Materials Science and Engineering Dept., North Carolina State Univ., Box 7907, Raleigh, NC (US)). pp 369-380 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The existing work on structure and mechanical behavior of intermetallic alloys containing dispersed second phases - dispersoids - is reviewed. The dispersoids considered in the review are those given the conventional definition as inert, stable, insoluble phases in the matrix, such as oxides. The only detailed mechanistic studies of dispersoids in intermetallics have been carried out on the model material Cu/sub 3/Au, and these did not include elevated temperature, e.g., creep, mechanical behavior. A number of investigations on dispersoids in the potentially important elevated temperature materials - the aluminides - are reviewed. The materials discussed include FeAl, Fe/sub 3/Al, NiAl, and Ti/sub 3/Al. Many of these studies are preliminary in nature and much more research and development is needed to allow for the design of intermetallic-dispersoid materials with improved fabricability and elevated temperature performance.

51653 **Ductility and fracture behavior of polycrystalline Ni/sub 3/Al alloys.** Liu, C.T. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 355-367 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

This paper provides a comprehensive review of the recent work on tensile ductility and fracture behavior of Ni/sub 3/Al alloys tested at ambient and elevated temperatures. Polycrystalline Ni/sub 3/Al is intrinsically brittle along grain boundaries, and the brittleness has been attributed to the large difference in valency, electronegativity, and atom size between nickel and aluminum atoms. Alloying with B, Mn, Fe, and Be significantly increases the ductility and reduces the propensity for intergranular fracture in Ni/sub 3/Al alloys. Boron is found to be most effective in improving room-temperature ductility of Ni/sub 3/Al with <24.5 at.% Al. The tensile ductility of Ni/sub 3/Al alloys depends strongly on test environments at elevated temperatures, with much lower ductilities observed in air than in vacuum. The loss in ductility is accompanied by a change in fracture mode from transgranular to intergranular. This embrittlement is due to a dynamic effect involving simultaneously high localized stress, elevated temperature, and gaseous oxygen. The embrittlement can be alleviated by control of grain shape or alloying with chromium additions. All the results are discussed in terms of localized stress concentration and grain-boundary cohesive strength.

51654 **Effect of aluminum addition on ductility and yield strength of Fe/sub 3/Al alloys with 0.5 wt % TiB/sub 2/.** McKamey, C.G.; Horton, J.A.; Liu, C.T. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp 321-328 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Studies have been conducted of the mechanical properties of Fe/sub 3/Al alloys containing 24 to 30 at.% Al, to which 0.5 wt% TiB/sub 2/ was added for grain refinement. In tensile tests conducted at room temperature, it has been found that, as the aluminum content is increased, the yield strength decreases sharply from 760-310 MPa. The decrease in yield strength is accompanied by a four-fold increase in room-temperature ductility. Ordered iron aluminides (containing no disordered α phase) showed a clear increase in yield strength with temperature above 300°C. Their strength reached a maximum around 600°C, above which it decreased sharply. All these results are discussed and correlated with stability of superlattice dislocations as a function of aluminum content.

51655 **Kinetics of oxidation of Ni aluminide exposed to oxygen-sulfur atmospheres.** Natesan, K. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL (US)). pp 459-466 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

As part of a development effort on nickel aluminides based on Ni/sub 3/Al as structural materials for fossil energy applications, oxidation/sulfidation studies are being conducted at Argonne National Laboratory on materials that are being developed at Oak Ridge National Laboratory. Sheet samples of nickel aluminide, containing 23.5 at.% Al, 0.5 at.% Hf, and 0.2 at.% B were tested in an annealed condition and after preoxidation treatments. Continuous weight-change measurements were made at 875°C by a thermogravimetric technique in exposure atmospheres of air, a low-pO/sub 2/ gas mixture, and low-pO/sub 2/ gas mixtures with several levels of sulfur. Detailed analyses of the corrosion product scale layers were conducted using a scanning electron microscope equipped with an energy dispersive x-ray analyzer and an electron microprobe. The air-exposed specimens developed predominantly nickel oxide; the specimen exposed to a low-pO/sub 2/ environment developed an aluminum oxide scale. As the sulfur content of the gas mixture increased, the alumina scale exhibited spallation and the alloy tended to form nickel sulfide as the reaction phase. The results indicated that the sulfidation reaction in nickel aluminide specimens (both bare and preoxidized) was determined by the rate of transport of nickel from the substrate through the scale to the gas/alumina scale interface, mechanical integrity of the scale, and the H/sub 2/S concentration in the exposure environment.

51656 **Pinhole camera for viewing electron beam materials processing.** Rushford, M.C.; Kuzmenko, P.J. (Lawrence Livermore National Lab., P.O. Box 808, L-470, Livermore, CA (US)). pp 333-338 of Optical techniques for industrial inspection. Cielo, P.G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

A very rugged, compact (4 x 4 x 10 inches), gas purged "PINHOLE CAMERA" has been developed for viewing electron beam materials processing (e.g. melting or vaporizing metal). The video image is computer processed, providing dimensional and temperature measurements of objects within the field of view, using an IBM PC. The "pinhole camera" concept is similar to a TRW optics system for viewing into a coal combustor through a 2 mm hole. Gas is purged through the hole to repel particulates from optical surfaces. In the authors' system light from the molten metal passes through the 2 mm hole "PINHOLE", reflects off an aluminum coated glass substrate and passes through a window into a vacuum tight container holding the camera and optics at atmospheric pressure. The mirror filters out X rays which pass through the AL layer and are absorbed in the glass mirror substrate. Since metallic coatings are usually reflective, the image quality is not severely degraded by small amounts of vapor that overcome the gas purge to reach the mirror. Coating thicknesses of up to 2 microns can be tolerated. The mirror is the only element needing occasional servicing. The authors used a telescope eyepiece as a convenient optical design, but with the traditional optical path reversed. The eyepiece images a scene through a small entrance aperture onto an image plane where a CCD camera is placed. Since the iris of the eyepiece is fixed and the scene intensity varies it was necessary to employ a variable neutral density filter for brightness control. Devices used for this purpose include PLZT light valve from Motorola, mechanically rotated linear polarizer sheets, and nematic liquid crystal light valves. These were placed after the mirror and entrance aperture but before the lens to operate as a voltage variable neutral density filter.

51657 **The disordering process in an Ll/sub 2/ ordered alloy.** Horton, J.A.; Das Gupta, A.; Liu, C.T. (Metals and Ceramics Div., Oak Ridge National Lab., P.O. Box X, Oak Ridge, TN (US)). pp 109-116 of High-temperature ordered intermetallic alloys. Koch, C.C.; Liu, C.T.; Stoloff, N.S. Pittsburgh, PA; Materials Research Society (1985). (CONF-8411308—).

From High-temperature ordered intermetallic alloys; Boston, MA, USA (26 Nov 1984).

The antiphase boundary (APB) structure and the disordering process have been studied by transmission electron microscopy (TEM) in a long-range-ordered alloy with Ll/sub 2/ structure and composition (Ni/sub 70/Fe/sub 30/)/sub 3/(V/sub 58/Al/sub 40/Ti/sub 2/). With an increase in temperature from a single-phase field into a two-phase field, disordering occurs both homogeneously within ordered domains and heterogeneously along PABs. Disordering continues by a ripening process with the disordered islands shrinking while the disordered bands on the prior APBs grow. The APBs are partially aligned on (100) while the material si single phase. As disordering proceeds, the degree of alignment of the disordered bands on (100) increases until complete alignment results. A correlation of the APB structure with room temperature mechanical properties indicates no dramatic change at the transition to the two-phase structure.

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REFER ALSO TO CITATION(S) 50498, 51165, 51349, 51349, 51350, 51350, 51353, 51448, 51538, 51562, 51563, 51566, 51602, 51603, 51611, 52784, 52789

51658 **(BNL—41471) Antiferromagnetism and mixed valency in $YBa_2Cu_3O_{6+x}$.** Tranquada, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880914—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015201/JAW.

From 18. rare earth research conference; Lake Geneva, WI, USA (11 Sep 1988).

Results of some recent neutron diffraction studies of antiferromagnetic ordering and x-ray absorption studies of Cu valence in $YBa_2Cu_3O_{6+x}$ will be reviewed. X-ray absorption measurements at the Cu K-edge demonstrate that when oxygen is removed from a CuO chain, the Cu^{2+} ions in that chain are converted to Cu^{1+}, thus helping to maximize the number of O 2p holes present in the orthorhombic phase, which in turn keeps the superconducting transition temperature high. Neutron diffraction studies have demonstrated that long-range antiferromagnetic ordering occurs throughout the tetragonal phase, predominantly due to Cu^{2+} ions in the CuO_2 planes. The increasing number of Cu^{2+} ions in chain sites with increasing oxygen content causes frustration in interplanar coupling, and eventually a change in spin structure. The recent growth of very large single crystals has made possible inelastic scattering studies of spin waves. 27 refs., 6 figs.

51659 **(BNL—41521) Antiferromagnetism in YBa_2Cu_3O/sub 6+x/.** Tranquada, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 16p. (CONF-880703—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015854/JAW.

From Joint INTERMAG: magnetism and magnetic materials conference; Vancouver, Canada (12 Jul 1988).

A number of models for high temperature superconductivity in the layered cuprate perovskites require strong antiferromagnetic superexchange interactions between Cu atoms. The existence of such interactions in La_2CuO/sub 4-y/ has previously been demonstrated. In this paper a review is given of recent neutron scattering work performed at Brookhaven studying antiferromagnetism in RBa_2Cu_3O/sub 6+x/ with R = Y, Nd. Measurements on ceramic samples with a range of oxygen concentrations have shown that 3D antiferromagnetic ordering of the Cu spins occurs throughout the nonsuperconducting tetragonal phase, corresponding to O ≦ x {approx←lt} 0.4. Near x {approximately} O the Cu^{2+} atoms in the CuO_2 layers form a simple Neel lattice, and there is no ordering of the nonmagnetic Cu^{1+} atoms in the "chain" sites. With increasing oxygen content some of the Cu^{1+} atoms are converted to Cu^{2+}, which leads to frustration of the interplanar coupling and eventually to a second type of ordering. Very recently, large single crystals of YBa_2Cu_3O/sub 6+x/ have been grown, making possible inelastic scattering studies of magnetic excitations. Spin waves within the CuO_2 planes are observed to have a velocity {approx←gt} 0.5 eV {angstrom}. 26 refs., 6 figs.

51660 **(CONF-8803139—1) Recent developments in the chemical processing of electrical ceramics.** Payne, D.A. (Illinois Univ., Urbana (USA). Dept. of Materials Science and Engineering). 1988. Contract AC02-76ER01198. 4p. NTIS, PC A02/MF A01. Order Number TI88014171/JAW.

From International forum on fine ceramics: fine ceramics for the future; Nagoya, Japan (1 Mar 1988).

A variety of chemical methods of ceramic processing have been developed, which include solution liquid-mix methods, co-precipitation, and sol-gel processing. This paper reports on, the (i) precipitation of colloidal particles by controlled nucleation and growth processes, for the preparation of powders with uniform composition and controlled morphology, which are used in thick-film capacitors; (ii) an alternate chemical processing route, known as polymeric mixed-alkoxide processing, which avoids powder, for the spin-casting of thin-layer devices on semiconductors; (iii) the feasibility of coating colloidal particles with alkoxide coatings for the chemical bonding of ceramics at reduced temperatures; and (iv) a liquid solution resin forming process, known as the Pechini method, for the preparation of superconducting ceramics.

51661 **(DOE/ER/01198—T30) Preparation of YBa_2Cu_3O/sub 7-δ/ from homogeneous metal alkoxide solution.** Fahrenholtz, W.G.; Millar, D.M.; Payne, D.A. (Illinois Univ., Urbana (USA)). 1988. Contract AC02-76ER01198. 7p. (CONF-8805123—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015272/JAW.

From Superconductor symposium; Cincinnati, OH, USA (1 May 1988).

Reactive, homogeneous 1:2:3 Y:Ba:Cu solutions, were prepared in 2- methoxyethanol, by reaction of $Y(OCH_2CH_2OCH_3)_3$, $Ba(OCH_2CH_2OCH_3)_2$, and a soluble copper alkoxide. The general insolubility of copper (II) alkoxides was circumvented by synthesizing the mixed-ligand species $(C_5H_7O_2)_2Cu_2(\mu\text{-}OCH_2CH_2CH_2OCH_3)_2$. Powders and thin layers were prepared. Data are reported for the chemical preparation method and material characteristics, as determined by x-ray diffraction, differential thermal analysis, and infrared spectroscopy. 10 refs., 5 figs.

51662 **(DOE/ER/45251—T1) NMR investigation of porous structures, ceramics and sandstones: Annual technical progress report.** Halperin, W.P. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics). Jan 1988. Contract FG02-86ER45251. 11p. NTIS, PC A03/MF A01. Order Number DE88006405/JAW.

In the past year we have continued our investigations of the fundamental aspects of NMR relaxation analysis of porous bodies and have opened two new directions. The first of these results from a strong collaborative arrangement established with BP/America. Here it has been possible to gain access to carefully controlled SiC powders and SiC green bodies for NMR relaxation characterization of their pore spaces. This work includes the first imaging results on a SiC rotor green body. Secondly, we have started a small processing program to prepare magnetic field aligned high T/sub c/ superconducting ceramics. Such c-axis aligned materials offer the potential for improved physical characterization since the principal anisotropy in physical measurement on superconducting compacts is associated with the c-axis. More important is the need to prepare the bulk superconducting materials with larger critical current densities. This might also be achievable using magnetic field induced alignment with "binderless" compaction methods that we are developing. 3 figs.

51663 **(EGG-M—88055) Sol-gel routes to superconducting ceramics.** Debsikdar, J.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 20p. (CONF-880431—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015128/JAW.

From International conference on the first two years of high-{Tc} superconductivity; Tuscaloosa, AL, USA (11 Apr 1988).

Potential processing advantages of sol-gel techniques for fabricating ceramic end products are discussed with special reference to some typical sol-gel approaches outlined in the literature for producing high temperature ceramic superconducting materials. Moreover, the current state of sol-gel research at the Idaho National Engineering Laboratory has been reported with reference to synthesis of metallo-organic precursor materials, sol-gel processing with those precursor materials, and characterization of high temperature superconducting materials in the $BaO\text{-}Y_2O_3\text{-}CuO$ system.

51664 **(EGG-M—88129) Eddy current measurements of the new high T/sub c/ ceramic superconductors.** Telschow, K.L.; Kunerth, D.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 8p. (CONF-880760—1). NTIS, PC A02/MF A01. Order Number DE88016951/JAW.

From Review of progress in quantitative nondestructive evaluation; La Jolla, CA, USA (31 Jul 1988).

The major properties of superconductors are zero resistance and diamagetism (Meissner effect). Eddy current techniques provide a means of determining these properties simultaneously with a noncontacting probe. We present the results of CW measurements obtained for YBa_2Cu_3O/sub 7-x/ prepared by solid state reaction and sol-gel powder fabrication techniques, along with concurrent DC resistive measurements of the transition. The data are interpreted in light of the sample's superconducting properties and the general effects of superconductivity on the eddy current measurement method. 5 refs., 5 figs.

51665 **(EGG-MS—8179) Detection and characterization of porosity in ceramic/ceramic composites.** Walter, J.B.; Lott, L.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 25 Jul 1988. Contract AC07-76ID01570. 32p. NTIS, PC A03/MF A01. Order Number DE88016965/JAW.

Ceramic composites are an important new type of material being developed for applications requiring high strength at high temperatures. This report focuses on composites of a SiC fabric reinforced SiC matrix formed by chemical vapor infiltration. This material is characterized by extensive porosity, which is known to limit its strength. Effective methods of nondestructively detecting and characterizing porosity in the material are needed. This is a challenging task for ultrasonics because of the high levels of porosity (>10%) found in the material and because of the intrinsic heterogeneity and anisotropy of the material, all of which strongly affect ultrasonic propagation. Techniques are described for measuring ultrasonic attenuation, transmitted energy, and propagation velocity using through transmission. Measurements are included which show correlation with the material porosity. A mathematical model was successfully developed to help understand the measurements and to permit extrapolation of the results to other sample sets. A comparison of the model to the measurements is reported. Implications of the model on the detection and resolution of individual voids and on distinguishing them from variations in the general porosity of the material are considered. 6 refs., 12 figs.

51666 (INIS-SU—15/A, pp 195-197) **Stability of defect structures in solid oxide electrolytes.** Vikhrenko, V.S.; Kulak, M.I.; Zharskij, I.M.; Pakhomov, V.P. (Belorusskij Tekhnologicheskij Inst., Minsk; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The defect structure in high-temperature solid electrolyte based on ZrO/sub 2/ and stabilized with Y or Ca was studied. A tendency to clustering was found to exist in a Ca-stabilized system because of mutual screening both of cation and anion defects . In Y-stabilized system no clustering tendency was observed because the doped cations cannot screen the vacancy interactions due to their low effective charges. The system was stable as compared to the Ca-stabilized one, but its stability decreased with temperature. Results obtained for simulated systems correlated well with experimental data. 1 ref.; 2 figs.

51667 **(LBL—25483) Exotic normal and superconducting properties of high T/sub c/ oxides and small E/sub f/.** Kresin, V.Z.; Deutscher, G.; Wolf, S.A. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 9p. (CONF-880522—2). NTIS, PC A02/MF A01. Order Number DE88016243/JAW.

From Latin-American conference on high-temperature superconductivity; Rio de Janeiro, Brazil (5 May 1988).

A key feature of the high T/sub c/ oxides is a very small value of the Fermi energy. This feature leads to peculiar thermodynamic and transport properties in the normal and superconductive state. 24 refs., 1 fig.

51668 **(LBL—25733) High T/sub c/ superconductors: Will they replace helium temperature superconductors for magnets?.** Green, M.A. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 6p. (CONF-880736—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016632/JAW.

From 12. international cryogenic engineering conference and exhibition; Southhampton, UK (12 Jul 1988).

This compares the properties of a Y-Ba-Cu-O high T/sub c/ conductor (T/sub c/ = 93 K) with niobium titanium (T/sub c/ = 9.4 K). If one assumes that the critical current density for the high T/sub c/ superconductor is the same as niobium titanium and they are both in a conducting matrix, one can make a direct comparison of the two types of superconductor. The comparisons in the paper include: adiabatic and dynamic stability diameter, normal region propagation rates, the burnout integral of J^2 dt, quench initiation energy, and matrix current density for cryogenic stability. From such a comparison, it is clear that high T/sub c/ superconductor may not be the superconductor of choice for many applications. An example of such an application is the use of high T/sub c/ conductors for accelerator magnets. 26 refs., 1 fig., 4 tabs.

51669 **(MINTEK-TR—1253) Method for production of vanadium pentoxide.** Stary, P.; Stamberg, J.; Peska, J.; Taborsky, J.; Kohout, Z.; Sindelar, V. (Council for Mineral Technology, Randburg (South Africa)). 29 Jan 1987. 11p. MINTEK, P O Box X3015, Randburg, 2125, South Africa.

Translation of a CS patent document No221056, published 30 06 81 and invented by the named authors.

This is an English translation of a Czechoslavakian patent which describes an invention for the production of vanadium pentoxide. The principle of the invention can be described as follows: inlet recirculated water is filtered using at least two layers of the base anion exchangers arranged in series, received reciprocating recirculated water free of chromium, but containing the initial amount of vanadium, is returned to the circuit of production of vanadium pentoxide. After the first layer of the base anion exchanger is saturated with chromium, the inlet recirculated water is fed to the second layer of the base anion exchanger. In the meantime, in the first layer of the anion exchanger, the hexavalent chromium is reduced and removed, using liquid phase, as a concentrated reclaimed chromium. The first layer of the base anion exchanger is used, after it was regenerated using the above method, for the filtration of the following portion of the inlet recirculated water. The invention also suggests the introduction of sulphur dioxide to the layer of the base anion exchanger which was saturated by hexavalent chromium to enable the reduction to the trivalent chromium.

51670 (MMIJ—8801, pp 49-50) **Characterization of functional materials by thermometry. New oxide high temperature super-conductive material.** Saito, Yasutoshi; Atake, Toru. (The Research Lab. of Engineering Materials, Tokyo Inst. of Tech., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Procceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Thermometry plays a very important role in the synthesis and characterization of new functional materials. Especially the precise specific heat measurement can not only determine various thermodynamic functions, but is a potential means to clarify the phase transformation phenomenon. Authors had already made an adiabatic calorimeter wherein the absolute value of the specific heat is reliable as little as 0.1%, and has studied new oxide super-conductive material. Samples were synthesized by burning the powder of $BaCO_3$, CuO and various oxides of rare earth metals. As for the 40K class super-conductive material, La/sub/1.85/Sr/sub/0.15/CuO_4 was synthesized in Feb. 1987 with electron specific heat 11 $mJ\text{-}K^{-2}mol^{-1}$. As for the 90K class material, a clear abnormality in specific heat was detected for a super-conductive material wherein Er or Dy was used instead of Y with the electron specific heat respectively of 32 or 30 $mJ\text{-}K^{-2}mol^{-1}$. (7 figs, 6 refs)

51671 (MMIJ—8801, pp 51-52) **Oxygen pressure and critical temperature of superconductive oxides.** Suzuki, Ryosuke; Oishi, Toshio; Ono, Katsutoshi. (Kyoto Univ., Faculty of Engineering, Kyoto, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Super-conductive characteristics of Ba_2TCu_3O/sub/x/ depend greatly on the sample-forming conditions, especially on the amount of oxygen (x). The objective of this study is to clarify the relation between the partial pressure of oxygen and the oxygen quantity and the critical temperature. In order to increase the amount of oxygen in the oxide, oxygen atmosphere higher than one atmospheric pressure was used. Ba_2YCu_3O/sub/x/ was prepared by reacting a powder mixture of Ba_2CO_3, Y_2O_3 and CaO in the air at 1203K and sintered, which was repeated to form a uniform ceramic. This is then cooled in the furnace at the cooling rate of 75K per hour. This oxide was confirmed by powder-X-ray diffraction to be of rhombic crystal. By keeping in equilibrium with high pressure oxygen, the super-conductive characteristics are not lost even when amended at high temperature. This is because the amount of oxygen-defect of the material is made less. (4 figs)

51672 **(NUREG/CR—5166) Electrochemical evaluation of solid state pH sensors for nuclear waste containment.** Huang, P.H.; Kreider, K.G. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; National Bureau of Standards, Washington, DC (USA). Center for Chemical Engineering). Jul 1988. 28p. (NBSIR—88-3790). NTIS, PC A03/MF A01 - GPO. Order Number TI88014912/JAW.

This report contains a literature review for electrochemical evaluation of solid state pH sensors. The requirements of pH electrode for geochemical fluids in a nuclear waste repository site are rather difficult to fulfill, that is, the electrode must have stability at temperatures up to 250{degree}C, low ionic and redox interferences, corrosion resistance, and robustness. Among the potential electrode materials, the IrO_2 emerges as the most promising because of its consistent near Nernstian response and its electrochemical behavior at the IrO_2-solution interface is essential in order to optimize the performance of IrO_2 electrodes for pH sensing at high temperatures and pressure. This report reviews theoretical models of the oxide-solution interfaces based on the theory of the electric double layer. Electrochemistry of IrO_2 films with emphasis on the properties of anodic films is summarized. A plan for pH testing of

sputtered iridium oxide films is summarized. A plan for pH testing of sputtered iridium oxide films (SIROF) for geochemical measurements at a Tuff Repository is described. 80 refs.

51673 **(PB—88-222187/XAB) EXAFS (Extended X-ray Absorption Fine Structure) study of the three cation environments in $Ba_2YCu_3O_7$.** Gurman, S.J.; Diakun, G.; Dobson, B.; Abell, S.; Greaves, G.N. (Daresbury Lab. (UK)). May 1988. 12p. (DL/SCI/P—582E). NTIS, PC E03/MF E03.

A multiple-shell, curved-wave EXAFS analysis of the spectra on the adsorption edges of all three cation species in the high-temperature superconductor $Ba_2YCu_3O_7$ is reported. No change in structure is observed between liquid nitrogen and room temperatures. However, there are considerable differences in Debye-Waller factors which demonstrate that the Cu-O bonds are extremely rigid in the material.

51674 **(PNL—6594) Laboratory testing of TiB_2-based cathodes for electrolytic production of aluminum.** Schilling, C.H. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. Contract AC06-76RL01830. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016180/JAW.

Experimental research was performed to evaluate TiB_2-based cathodes, which may be used for retrofitting existing commercial Hall-Heroult cells. Candidate cathode materials and retrofit designs were analyzed in laboratory-scale electrolysis tests and nonpolarized immersion tests in molten Al. The cathode materials and cathode attachment designs were selected based on a literature review (Schilling, Hagen, and Hart 1987) and previous experimental research at the Pacific Northwest Laboratory (Hart et al. 1987). 40 refs., 16 figs., 2 tabs.

51675 **(SAND—88-1930C) Investigations of superconducting and non-superconducting YBa/sub 2/Cu/sub 3/O/sub 7-x/ by field ion microscopy, atom-probe mass spectroscopy and field electron emission.** Kellogg, G.L.; Brenner, S.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880791—2). NTIS, PC A02/MF A01. Order Number TI88014972/JAW.

From 35. international field emission symposium; Oak Ridge, TN, USA (18 Jul 1988).

The structure and composition of superconducting and non-superconducting samples of the YBa_2Cu_3O/sub 7-x/ were examined by field ion microscopy, atom-probe mass spectroscopy and field-electron emission techniques. Field ion microscope images from both types of material exhibited ring structures associated with atomic or multiatomic layers and uniform, layer-by-layer field evaporation was possible. Atom-probe mass spectra contained signals corresponding to atomic and molecular oxygen, all three metals, and oxides of Cu and Y. Atom-probe mass spectra from the superconducting samples (x {approximately} 0.35) contained a much larger molecular oxygen signal than mass spectra from the non-superconducting samples (x {approximately} 0.8) indicating that oxygen in the CuO chains is field desorbed preferentially as molecular oxygen ions. Field electron emission from the superconducting samples exhibited normal Fowler--Nordheim characteristics above and below the superconducting transition temperature. Surface contaminates were found to decrease the work function of the material by as much as 39%. With the exception of one isolated experiment, no significant temperature effect on the field emission characteristics were observed. 13 refs., 6 figs.

51676 **Determination of oxygen content in high T/sub c/ superconductors by a charged particle activation method.** Tao, Z.; Alburger, D.E.; Jones, K.W.; Yao, Y.D.; Kao, Y.H. (Brookhaven National Laboratory, Upton, New York 11973). *Applied Physics Letters;* **53**: No. 15, 1440-1442(10 Oct 1988).

A new method for determining the oxygen content in high T/sub c/ superconductors has been demonstrated using a charged particle activation technique. This method allows a measurement of the concentration of ^{16}O atoms in the superconducting material by detection of the ^{17}F produced with the $^{16}O(d,n)^{17}F$ nuclear reaction. By way of example, this technique is applied to the determination of oxygen content in a series of high T/sub c/ Y-Ba-Cu-O samples in which the stoichiometry is varied by reducing the copper concentration. The stabilized oxygen content shows a nonlinear dependence on the copper deficiency in these specimens.

51677 **Electron irradiation induced amorphization in $YBa_2Cu_3O_7$ and $GdBa_2Cu_3O_7$ superconductors.** Nastasi, M.; Parkin, D.M.; Zocco, T.G.; Koike, J.; Okamoto, P.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **53**: No. 14, 1326-1328(3 Oct 1988).

Transmission electron microscope specimens of the oxide superconductors $YBa_2Cu_3O_7$ and $GdBa_2Cu_3O_7$ have been irradiated at 35 K with 1 MeV electrons and doses up to 1.5×10^{23} e/cm^2. Electron diffraction data show the two different superconductors do not respond similarly with $GdBa_2Cu_3O_7$ being more resistant to amorphization than $YBa_2Cu_3O_7$. Amorphization appears to be dependent on displacements occurring at the Y/Gd lattice site. In addition, it appears that within each material, the electron dose required to initiate amorphization is lower for grain boundary irradiations relative to large single grain irradiations.

51678 **Incommensurable magnetic surface structures for MnO-type antiferromagnetic insulators.** Chrzan, D.C.; Falicov, L.M. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 13, 1509-1511(26 Sep 1988).

A calculation of the magnetic (001) surface structure of an antiferromagnetic insulator with the MnO spin arrangement is reported. The calculation is based on classical spins with Heisenberg interactions which are (a) between second neighbors throughout the bulk and surface, (b) between nearest-neighbor spins at the surface layer, and (c) between nearest-neighbor spins in the first and second layers. It is found that for a range of exchange parameters, incommensurable ground-state structures are obtained.

51679 **Superconducting properties of La/sub 2-//sub x/ Ba/sub x/CuO_4.** Moodenbaugh, A.R.; Xu, Y.; Suenaga, M.; Folkerts, T.J.; Shelton, R.N. (Division of Materials Science, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 7, 4596-4600(1 Sep 1988).

We show that the superconducting transition temperature T/sub c/ of La/sub 2-//sub x/Ba/sub x/CuO_4 as a function of barium content ($0 \leq x \leq 0.25$, determined by mutual inductance measurements) has two maxima, both T/sub c/$\approx$25 K, near compositions x = 0.09 and x-0.15. Between these two maxima is a local minimum (T/sub c/ about 5 K) for x = 0.12. dc magnetization data are also reported for six compositions. Anomalies in electrical resistance appear near T = 50—60 K at compositions $0.10 \leq x \leq 0.125$. Many samples clearly show a second resistive superconducting transition near 30 K in addition to the bulk transition most clearly observed magnetically. The variation of T/sub c/ with composition is discussed in relation to the occurrence of resistance anomalies. The tetragonal lattice parameters at room temperature are consistent with previous work, and show no obvious anomalies. The sample preparation procedures are discussed in detail.

51680 **Spin-singlet pairing mechanism in magnon-pairing theories.** Doria, M.M.; Borges, H.A. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 7, 4999-5001(1 Sep 1988).

A microscopic model producing hole attraction in the CuO_2 planes is proposed based on competing magnetic interactions. The present mechanism differs from the recent theories of Goddard and co-workers and Aharony and co-workers by the fact that the pairing here is exclusively of singlet type.

51681 **Identification of a superoxide in superconducting La_2CuO/sub 4+//sub δ/ by x-ray photoelectron spectroscopy.** Rogers J.W. Jr.; Shinn, N.D.; Schirber, J.E.; Venturini, E.L.; Ginley, D.S.; Morosin, B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 7, 5021-5024(1 Sep 1988).

X-ray photoelectron spectroscopic and annealing studies of ceramic $La_2CuO_{4+\delta}$ prepared by high-temperature and high-pressure oxygen enrichment have identified a superoxide as the predominant oxygen species ($\delta \cong 0.13$) correlated with a superconducting transition at $T_c \cong 30$ K.

51682 T^4 to T^2 resistivity transition and superconducting fluctuations in disordered VN films. Zasadzinski, J.F.; Saggese, A.; Gray, K.E.; Kampwirth, R.T.; Vaglio, R. (Illinois Institute of Technology, Chicago, Illinois 60616). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 5065-5068(1 Sep 1988).

Thin films of Vn have been prepared with a wide range of structural disorder as characterized by residual resistivities from the clean value of $\rho_0 = 5.0$ $\mu\Omega$ cm up to 100 $\mu\Omega$ cm. The disorder is primarily a consequence of nitrogen vacancies in as-made films or α-particle damage of clean, stoichiometric VN. We have observed a transition in the power-law dependence of the low-temperature resistivity from T^4 to T^2 as disorder increases, consistent with the universal behavior of strong-coupled superconductors proposed by Gurvitch. Comparison of this transition with the universal plot leads to an estimate of the electron-phonon coupling λ_p between 1.0 and 1.1. Disordered films also display an enhanced conductivity several degrees above T_c which is well described by a model of three-dimensional (3D) superconducting fluctuations. This represents one of the few cases where fluctuation enhanced conductivity has been observed in 3D films, other cases being the high-T_c oxides such as $YBa_2Cu_3O_7$.

51683 Microwave collective transport in single-crystal Eu_2CuO_4. Reagor, D.W.; Migliori, A.; Fisk, Z.; Taylor, R.D.; Martin, K.A.; Ryan, R.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 5106-5109(1 Sep 1988).

We measured the complex conductivity of single crystals of Eu_2CuO_4 from 3 to 15 GHz and observed collective transport with a sample-independent spectral weight. An unusual activated temperature dependence for the spectral weight, and anomalous temperature dependence of the Eu Mossbauer line, indicate magnetic effects well above the Neel temperature. The collective transport is similar to that observed in $(TMTSF)_2PF_6$ where TMSF denotes tetramethyltetrathiofulvalene and where charged, massive solitons are the suspected source of the transport.

51684 Effect of microstructure on positron-annihilation parameters in $YBa_2Cu_3O_{7-x}$. Usmar, S.G.; Lynn, K.G.; Moodenbaugh, A.R.; Suenaga, M.; Sabatini, R.L. (Materials Science Division, Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 5126-5129(1 Sep 1988).

The temperature dependence of positron Doppler line shape has been measured for several samples of $YBa_2Cu_3O_{7-x}$ ($x \leqq 0.1$). Two distinct temperature dependences have been observed. In one case the line-shape parameter S increases by $\cong 0.5\%$ between 15 and 100 K, remains constant between 100 and 230 K, and then decreases by $\cong 0.25\%$ between 230 and 290 K. In the second case, S remains constant between 20 and 100 K, decreases by $\cong 1\%$ between 100 and 200 K, and then remains constant up to 290 K. Room-temperature positron-lifetime measurements also reveal distinct differences between samples. An explanation of these differences based on micro- structural differences observed by transmission electron microscopy is suggested.

51685 Thallium thin films. Kang, J.; Kampwirth, R.; Gray, K. *Supercurrents (Belmont) (California);* **5**: 23-27(Jun 1988).

Researchers at Sandia National Laboratories, Argonne National Laboratory, and IBM Alamden Research Center have created thin films from thallium barium calcium copper oxide (TlBaCaCuO). Their work which is discussed here, has given us higher T_c's in thin films, appreciation for the properties of the thallium system, and provocative ideas about structure-property relationships.

51686 Interface formation: High-temperature superconductors with noble metals, reactive transition metals, and semiconductors. Gao, Y.; Meyer H.M. III; Wagener, T.J.; Hill, D.M.; Anderson, S.G.; Weaver, J.H.; Flandermeyer, B.; Capone D.W. II. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, MN 55455). *AIP (American Institute of Physics) Conference Proceedings;* **165**: No. 1, 358-367(25 Feb 1988). (CONF-871178—).

From Thin film processing and characterization of high temperature superconductors; Anaheim, CA, USA (6 Nov 1987).

X-ray photoemission and inverse photoemission have been used to study interface formation between La/sub 1.85/Sr/sub 0.15/CuO_4 or $YBa_2Cu_3O_{6.9}$ and overlayers that include noble metals (Au, Cu), transition metals (Ti, Fe), and semiconductors (Ge). While Au passivates the surface, the reactive transition metals and Cu deplete oxygen from the substrate and form heterogeneous metal-oxide overlayers over a scale of a few tens of Angstroms. Reaction is observed for Ge, but to a lesser degree than for the reactive metals, Changes in the substrate core level and valence band spectra indicate regions rich in adatom-induced reactions and the consequences in terms of suppression of superconductivity are discussed.

3606 Other Materials

REFER ALSO TO CITATION(S) 50715, 50823, 50823, 50981, 50982, 51015, 51016, 51054, 51091, 51522, 51602, 51612, 51668, 51752, 51763, 51764, 51765, 51769, 51861, 51916, 51917, 51918, 52598, 52772, 52773, 52783

51687 (AD-A—193550/1/XAB) Control of dislocations in GaAs grown on Si(211) by molecular beam epitaxy. Ahearn, J.S.; Uppal, P.; Liu, T.K.; Kroemer, H. (California Univ., Santa Barbara (USA)). Aug 1987. 13p. (DAAG—29-85-K-0107). NTIS, PC A03/MF A01.

Pub. in Jnl. of Vacuum Science and Technology, Vol. B5, No. 4, 1156-1161(Jul-Aug 1987).

The dislocation arrangements in gallium arsenide films grown on silicon substrates with (211) surface orientations were directly determined using transmissions-electron microscopy in planar and cross-sectional views. The dislocations consisted of high-density networks at the GaAs-Si interface and arrays of linear dislocations that propagated from the interface to the surfacer of the film on the (111) planes. Burger's-vector determination of the arrays indicated that dislocations are introduced into the film primarily by a glide and that the linear arrays are a remnant of the interface network. When strained-layer InxGaS(1-x)As/GaAs superlattices were used, the linear arrays were observed to form a closed dislocation network, with the top of the loop structure coincident with the top of the superlattice. The dislocation density was markedly reduced above the superlattice. Results indicate that careful control of the strain can be an effective means of altering dislocation distributions in the films.

51688 (AGF—8601) Reports of the Asahi Glass Foundation for Industrial Technology. (Asahi Glass Foundation for Industrial Technology, Tokyo (Japan)). 25 Nov 1986. Vp. (In Japanese). Asahi Glass Foundation for Industrial Technology, 2-2-1 Marunouchi, Chiyoda-ku, Tokyo.

Individual papers are processed separately. (DLC)

51689 (CNIC—00125) 'In situ' expanded graphite extinguishant. Cao Qixin; Shou Yuemei; He Bangrong. (Southwest Inst. of Nuclear Reactor Engineering, SC (China)). (China Nuclear Information Centre, Beijing, BJ). 1987. 8p. (In Chinese). (SINRE—0008). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704103/JAW.

This report is concerning the development of the extinguishant for sodium fire and the investigation of its extinguishing property. The experiment result shows that 'in situ' expanded graphite developed by the authors is a kind of extinguishant which extinguishes sodium fire quickly and effectively and has no environment pollution during use and the amount of usage is little.

51690 **(DOE/PC/91024—T7) Characterization and fundamental studies on CuO sorbent materials to determine attrition mechanisms on substrate gamma lumina: Technical progress report No. 6 for the period December 23, 1987--March 23, 1988.** Mote, J.D.; Eucker, P.; Naziripour, A.; Zillman, W. (Denver Univ., CO (USA). Dept. of Engineering). 1988. Contract AC22-86PC91024. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016253/JAW.

Additional results are presented concerning the effect of the morphology, size and size distribution of the pores on the mechanical strength of the alumina spheres utilized as sorbent reactant support material. In the last progress report the possibility of the pores acting as internal cracks was explored. This report extends the investigation to considerations of the role of surface roughness and surface cracks (probably resulting from porosity) on the mechanical strength of the sorbent materials. 9 figs.

51691 **(DPST—86-740) Effect of glass composition on surface tension, viscosity, and redox equilibria of initial DWPF [Defense Waste Processing Facility] glass.** Plodinec, M.J. (Savannah River Lab., Aiken, SC (USA)). 30 Oct 1986. Contract AC09-76SR00001. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015687/JAW.

A statistically-designed mixture study was undertaken to determine the effect that compositional variation in simulated Savannah River nuclear waste glass has upon melt surface tension, viscosity and Fe^{2+}/Fe^{3+} equilibria. In each case, linear models adequately predicted these properties from the SiO_2, B_2O_3, Na_2O, Li_2O and K_2O contents of the borosilicate glass. Surface tension at 1150{degree}C increases with increasing SiO_2 or Li_2O content, viscosity increases with increasing SiO_2 content and the Fe^{2+}/Fe^{3+} ratio increases with additions of SiO_2, B_2O_3 or Li_2O at constant temperature and partial pressure of oxygen. Addition of the other oxides decreases the values of these properties. Surface tension was additionally found to decrease under more oxidizing melt conditions and with water vapor present in the atmosphere. The Fe^{2+}/Fe^{3+} ratio only changed by 0.05 over the range of compositions tested, which suggests that compositional variation in the vitrification process will likely not adversely affect its use as a monitor of the glass oxidation state. 18 refs., 6 figs., 3 tabs.

51692 **(EMR—8802) Study to determine the feasibility of asbestos cement sheets as cladding for concrete offshore structures.** (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Feb 1988. 22p. (MICROLOG—88-03152). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The purpose of this study was to determine the feasibility of using asbestos cement sheets as cladding against ice action in concrete offshore structures. Physical properties and cost factors were compared for asbestos cement, steel sheets, steel and Teflon, and high strength concrete. The comparison shows that asbestos cement is not well suited to the proposed use. A library search produced only one relevant research paper. Asbestos cement has been tested in seawater (but not in a cold climate) and in the laboratory to examine its properties for use a sheet piling in a marine evironment. The results for normal and for autoclaved asbestos cement were not encouraging. Extracts from the report are included. The information available strongly suggests that asbestos cement is not well suited to the proposed use on offshore structures. To show this conclusively, it is recommended that tests on asbestos cement in cold seawater be conducted, and the results compared to those for high strength concrete and for steel sheets. These materials are considered to be more appropriate for providing protection to offshore structures. 1 ref., 3 tabs.

51693 (INIS-mf—11309, pp 116) **Dynamic nuclear polarization studies of a molecularly doped polymer.** Wind, R.A.; Li, Liyun; Maciel, G.E.; Zumbulyadis, N.; Young, R.H. (Colorado State Univ., Fort Collins (USA). Dept. of Chemistry; Eastman Kodak Co., Rochester, NY (USA)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51694 (INIS-mf—11309, pp 102-103) **Domain structure of distinct silica gels revealed by /sup 29/SI-CP-MAS spectroscopy.** Pfleiderer, B.; Albert, K.; Bayer, E.; Haan, J.W. de; Ven, L.J.M. de. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Organische Chemie; Technische Univ. Eindhoven (Netherlands)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51695 (INIS-mf—11309, pp 145-146) **Quadrupole coupling tensor of /sup 95/Mo in Mesitylene Molybdenum tricarbonyl.** Huis, L.; Pouwels, J.W.; MacLean, C. (Amsterdam Univ. (Netherlands). Lab. voor Fysische Chemie). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

The quadrupole coupling tensor of /sup 95/Mo in Mesitylene Molybdenum tricarbonyl has been determined in benzene solution with NMR of the dielectrically oriented molecule.

51696 (INIS-mf—11309, pp 114) **Distribution of rotational angles from deuteron 2D-exchange spectra.** Wefing, S.; Kaufmann, S.; Spiess, H.W. (Max-Planck-Institut fuer Polymerforschung, Mainz (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51697 (INIS-mf—11309, pp 108-109) **NMR study of the diffusion in spatially nonuniform liquid crystals.** Vilfan, M.; Zumer, S. (Ljubljana Univ. (Yugoslavia)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51698 (INIS-mf—11309, pp 100-101) **Two-dimensional quadrupolar echo spectroscopy of I>1 nuclei. Spin relaxation in anisotropic systems.** Halle, B.; Wong, Tuck C.; Furo, I. (Lund Univ. (Sweden)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51699 (INIS-mf—11309, pp 95) **Spin dynamics and ferro to paraelectric transition in poly-vinylidene fluoride-trifluoro ethylene copolymer.** Meurer, B.; Hirschinger, J.; Weill, G. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51700 (INIS-mf—11309, pp 94) **High-speed /sup 27/Al and /sup 29/Si MAS NMR studies of zeolite structures and clays. Determination of /sup 27/Al quadrupole coupling constants and accurate /sup 27/Al chemical shifts.** Jacobsen, H.; Bildsoee, H.; Jakobsen, H.J. (Aarhus Univ. (Denmark)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51701 (INIS-mf—11309, pp 89-90) **Magnetic shielding tensor components in highly strained phosphines.** Barra, A.L.; Robert, J.B. (Centre National de la Recherche Scientifique, 38 - Grenoble (France). Service National des Champs Intenses). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51702 **(KFK—4364) OPTIMA II - computation of the optical properties of homogeneous infinite cylinders.** Bach, A.; Metzig, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). May 1988. 38p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754303/JAW.

Based on the OPTIMA code for computation the scattering properties of single homogeneous or coated Mie-particles an expansion is introduced for computation the scattering properties of homogeneous infinite cylinders. The exact Mie-functions as well as their solutions are presented. The numerical solutions for the complex Mie-coefficients are compared with the exact values. All derived quantities can be calculated by analogy to the OPTIMA code.

51703 **(LA—11411-T) SiC whisker-reinforced $MoSi_2$.** Carter, D.H. (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88016674/JAW.

The mechanical characteristics of an intermetallic matrix with two different reinforcements were studied. The matrix materials was $MoSi_2$, with two different reinforcements, Los Alamos VLS SiC whiskers and Huber VS SiC whiskers. The purpose of the reinforcement was to provide toughening at ambient temperature and strengthening at elevated temperatures. The VLS whiskers doubled the strength of the matrix at 1200{degree}C, and greatly improved the ambient temperature toughness of the matrix. The VS whiskers were added because they are much smaller in length and diameter, and therefore decreased the mean free path between whiskers, at the same volume fraction. The VS whiskers improved the toughness of the matrix at ambient temperature, and more than tripled the strength of $MoSi_2$ at elevated temperatures. The high strength of this new composite places this material in the realm of attractive engineering materials for high-temperature applications. A method to quantitatively describe fracture surfaces was used to study these composites. This induced the use of three-dimensional representations of the fracture surface, from which quantitative information about the roughness was obtained. 69 refs., 80 figs., 11 tabs.

51704 **(LBL—25173-Rev.) Microstructural study of an iron silicate catalyst using electron microscopy.** Csencsits, R.; Gronsky, R. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 15p. (CONF-880912—13-Rev.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014815/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

The effects of various synthesis conditions on the structure of iron silicate analogs of zeolite ZSM-5 were considered. Scanning electron microscopy (SEM) was used to determine the particle size distributions and morphologies. Particle sizes vary from tenths of a micron to several microns, depending on degree of agitation during crystal growth, while morphology is additionally dependent on the concentration of iron in the gel during crystallization. Transmission electron microscopy (TEM) was used to determine the size and spatial distributions of iron-rich (as compared to the FeZSM-5 matrix) second phase particles within the ZSM-5 framework as a function of SiO_2/Fe_2O_3-ratio, thermal and hydrothermal treatments. 9 refs., 6 figs.

51705 **(LBL—25604) Characterization of as-grown and annealed GaAs: Structural defects and electrical properties.** Lee, B.T. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016669/JAW.

Structural defects in GaAs related to excess As were characterized and their behavior upon heat treatments studied. The observed defects included precipitates and dislocations. Results showed most of the precipitates in As-rich GaAs to the rhombohedral arsenic. Two exceptions were observed in an In-doped LEC (liquid encapsulated Czochralski) GaAs, which were As-rich but could not be further identified. Some of the observed As precipitates showed a simple orientation relationship with the matrix which yields structural coherence between As precipitates and GaAs matrix. Other As precipitates showed less coherent orientation. The dislocation loops in As-rich GaAs consisted a faulted loop with Shockley type Burgers vector and a perfect loop associated with an extra {l←brace}111{r←brace} plane. It was proposed that these loops were formed as a result of dual condensation of both excess As interstitials and Ga vacancies, followed by generation and movement of Shockley partial dislocations. These precipitates and dislocation loops disappear after annealing, indicating a solvus temperature between 600–700{degree}C. The EL2 concentration increased as the defects dissolved, showing the defects to be the source of the excess As required to form EL2. The implication is that the As interstitial and Ga vacancies coexist in GaAs at high temperatures, which indicates that these point defects are responsible for the formation of arsenic antisites by direct combination. During the cooling period, they freeze into the matrix as point defects during a rapid cooling and condense as dislocation loops and precipitates during very slow cooling, in the dislocation-free region of the crystals. Around dislocations, the excess As precipitates heterogeneously even during rapid cooling. 217 refs.

51706 **(LBL—25689) A comparison of the pressure-induced deep donors in GaAs:Si and the DX centers in GaAlAs:Si alloys.** Li, M.F.; Yu, P.Y.; Shan, W.; Hansen, W.L.; Weber, E.R. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 4p. (CONF-880884—3). NTIS, PC A02/MF A01. Order Number DE88016666/JAW.

From 19. international conference on the physics of semiconductors; Warsaw, Poland (1 Aug 1988).

A comparison is made between the emission and capture activation energies of the pressure-induced deep donors in GaAs (both with and without boron) and the DX center in AlGaAs. It is suggested that the emission and capture activation energies of the DX center are influenced by its next nearest neighbors. 10 refs., 1 fig., 2 tabs.

51707 **(LBL—25690) Pressure dependence of of the DX center in Al/sub 0.35/Ga/sub 0.65/As:Te.** Li, M.F.; Shan, W.; Yu, P.Y.; Hansen, W.L.; Weber, E.R.; Bauser, E. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 6p. (CONF-8808106—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016645/JAW.

From 15. international conference on defects in semiconductors; Budapest, Hungary (22 Aug 1988).

The pressure dependence of the DX center in Al/sub 0.35/Ga/sub 0.65/As:Te has been studied by Deep Level Transient Spectroscopy using a diamond anvil high pressure cell. The results confirm that the effects of pressure and increase in Al concentration on the DX center are qualitatively similar though quantitatively different. Specifically, the pressure coefficients of the activation energies for emission were found to change sign when the bandgap of AlGaAs changed from direct to indirect. On the other hand, emission energy has been reported to be independent of Al concentration. Based on our results we conclude that the X conduction band minima also play a significant role in the DX center wavefunction. 12 refs., 4 figs.

51708 **(NAL-TR—927) Fracture mode research of boron aluminum composite materials by acoustic emission (AE).** Sofue, Yasushi; Ogawa, Akinori. (National Aerospace Lab., Chofu, Tokyo (Japan)). Mar 1987. 18p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770165/JAW.

AE characteristics were investigated with six types of tension test specimens of boron reinforced aluminium composite materials. The AE amplitude was above 90 dB for the fibre breakage of the unidirectional ply test piece. The fracture started immediately prior to final breakage and the fibre fracture during loading process was not found. AE count rate for the 90 degree fibre layers of 0

degree/ 90 degree laminated fibre test specimen was remarkably higher than those of other specimens. But this fibre fracture generally indicated the lower amplitude distribution than that of the unidirectional ply test specimen. Exfoliation of laminated zones was matrix fracture from the test result of the both side ditched specimen(a) with 3mm ditch width, so that shearing fracture of the matrix was also thought to be low amplitude fracture. The high amplitude fracture was found in the both side ditched specimen with 6mm ditch width(b). When the both side ditched specimen with 4mm ditch width was tested, mixed fracture modes of both above (a) and (b) were found and mixed AE characteristics were also found. (24 figs, 1 tab, 9 refs)

51709 **(UCRL—21061) Photographic documentation for AGT-86 Survivability of Coatings (SOC) Program.** Wirtenson, G.R. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88014167/JAW.

Microphotographs are given of the 23 coating designs tested in the 1986 Aboveground Test fielded at the Blackjack 5 facility operated by Maxwell Laboratories. Details of the coating preparation methods, test results, diagnostic and computational methods can be found elsewhere. 8 refs., 93 figs., 2 tabs.

51710 **Surface states and the temperature dependence of microindentation damage in silicon.** Danyluk, S.; Lee, S. (University of Illinois at Chicago, Department of Civil Engineering, Mechanics and Metallurgy, Chicago, Illinois 60680). *Journal of Applied Physics;* **64**: No. 8, 4075-4081(15 Oct 1988).

The interrelationship between mechanical and electronic properties of crystalline semiconductors has been explored through indentation of doped single-crystal silicon. The indentations were etched and the damage that extended beyond the immediate contact zone has been measured as a function of isothermal temperature of the silicon during the indentation. The damage zone exhibited a maximum at 150 °C. The surface properties of the silicon have been modeled with a finite, fixed number of surface states which possess an energy within the band gap. The spatial extent (Debye length) of the space-charge region has been calculated as a function of temperature, doping level, surface state energy, and density. The temperature variation of the Debye length is similar to that of the experimentally measured damage zone size when the indentation load was 0.49 N; both range in the 10^{-6} m and exhibit a maximum with temperature. The model implies that the deformation mode of silicon may be additionally influenced by external applied voltages, suitable doping, and/or surface preparation.

51711 **New varistor material.** Modine, F.A.; Hyatt, H.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6030). *Journal of Applied Physics;* **64**: No. 8, 4229-4232(15 Oct 1988).

A composite varistor material containing silicon carbide, a conductor, and an insulator has been developed. The material has rubberlike flexibility and is easily formed. A higher leakage resistivity ($\sim 10^{12}$ Ω cm) and greater nonlinearity (~ 10) than for silicon carbide varistors permit the material to be used as a gapless surge suppressor. The breakdown voltage (1—10 kV/cm) and other properties of the material vary with composition. High current capability (>200 A/cm^3) and good energy absorption (>40 J/cm^3) are obtained. Also, the material exhibits a low-temperature coefficient ($\sim 4 \times 10^{-3}$/K) and a low dielectric constant (~ 10) with no observed loss peak.

51712 **Damage nucleation and annealing in MeV ion-implanted Si.** Holland, O.W.; El-Ghor, M.K.; White, C.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6057). *Applied Physics Letters;* **53**: No. 14, 1282-1284(3 Oct 1988).

The damage produced in Si by high-energy MeV ions and its low-temperature annealing behavior are discussed. The damage morphology clearly shows that there are distinct regions in which different damage nucleation and growth mechanisms are dominant. A model is proposed to account for the observations. Both electron microscopy and Rutherford backscattering were used to characterize the damage distributions, while the annealing behavior of the damage helped in identifying some of the defects.

51713 **Tricritical behavior of polymers with loops.** Lim, H.A.; Guha, A.; Shapir, Y. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306-4052). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3710-3720(1 Oct 1988).

We study by exact enumerations a lattice model of polymers with fused loops (which also describes polymèric networks with even functional units). As the relative concentration of fused crossings of the chain (or that of the tetrafunctional units in the network) is increased, the conformations change their shapes from swollen (with self-avoiding-walk scaling properties) to compact. Earlier renormalization-group studies predicted the tricritical point associated with this transition to be in a new universality class, distinct from the Θ point. In particular, non-Gaussian behavior with ν/sub t/$<(1/2$ and γ/sub t/<1 in three dimensions (3D) was predicted. We have enumerated all conformations according to their length l and number of crossings (or tetrafunctional units) I with their end-to-end distance r, on triangular (up to l = 15, I = 7), square (l = 21, I = 7), and cubic (l = 15, I = 5) lattices. The locations of their respective transitions are determined from the divergence of the specific-heat plots. Tricritical couplings and exponents are extracted by a D log Pade analysis. The tricritical scaling exponents we find are ν/sub t/$\cong 0.52(2)$, γ/sub t/$\cong 1.25(20)$ in 2D, and ν/sub t/$\cong 0.465(10)$, γ/sub t/$\cong 0.60(5)$ in 3D, in fair agreement with the renormalization-group predictions.

51714 **Layer growth and dynamics of xenon films deposited on Ag(111).** Qian, X.; Bretz, M. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48109). *Physical Review Letters;* **61**: No. 13, 1497-1500(26 Sep 1988).

We have used a surface-plasmon-resonance technique to probe Xe multilayer-film growth dynamics on vapor-deposited Ag(111) from 67 to 85 K. At low T, more than 10 statistical layers are observed, but above 75 K, films complete only about 2 layers before nucleating islands. We discuss activation energies, long-term instabilities, and annealing trends, and show that the isalnd nucleation correlates with underlying features of the substrate.

51715 **Thermodynamic stability of (AlAs)/sub n/(GaAs)/sub n/ superlattices and the random Al/sub 0.5/Ga/sub 0.5/As alloy.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review Letters;* **61**: No. 13, 1505-1508(26 Sep 1988).

We calculate the total energy of random Al/sub 0.5/Ga/sub 0.5/As alloys and ordered (AlAs)/sub n/(GaAs)/sub n/ superlattices through a series expansion in multi-atom interaction energies obtained from the local-density formalism. We find that the alloy is more stable than the monolayer (n = 1) superlattice at all temperatures, but it could order into longer-period ($n \geq 2$) superlattices below a critical temperature T(n,G) calculated for various growth orientations G.

51716 **Coverage and chemical dependence of adsorbate-induced bond weakening in metal substrate surfaces.** Sette, F.; Hashizume, T.; Comin, F.; MacDowell, A.A.; Citrin, P.H. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **61**: No. 12, 1384-1387(19 Sep 1988).

Strongly coverage-dependent outward relaxation and enhanced in-plane vibrational amplitudes of metal surface atoms have been observed from S- and Cl-covered Ni(001) and Cu(001) by means of temperature- and polarization-dependent surface extended-x-ray-absorption fine-structure measurements. These results explicitly demonstrate the weakening of both interlayer and intralayer metal-metal substrate bonds. A model based on adsorbate-metal charge rearrangement explains these chemisorption-induced changes in the geometric and dynamic properties of the metal surface.

51717 **Infrared laser heating for studies of cellulose degradation.** Jackson, J.P.; Arthurs, E.; Schwalbe, L.A.; Sega, R.M.; Windish, D.; Long, W.H.; Stappaerts, E.A. (Kaman Sciences, 1500 Garden of the Gods Road, Colorado Springs, Colorado 80907). *Applied Optics;* **27**: No. 18, 3937-3943(15 Sep 1988).

We describe a new technique for studying thermally induced chemical transformations in cellulose. The apparatus consists of a carbon dioxide laser for heating, an IR thermometer, and an optical reflectance spectrometer for tracking the progressive discoloration of the sample. To illustrate the technique, we present measurements from a single piece of sample linen along five isotherms in the 200—290°C range. We derive an algebraic expression for the reflectivity of the sample as a function of the areal concentrations of the chromophoric states produced at temperature. The results are then explained in terms of first-order chemical rate theory and a four-step model. From the measurements we derive the activation energies, Arrhenius constants, and reflectivities of the chromophoric states.

51718 **Fluorination of amorphous thin-film materials with xenon fluoride.** Weil, R.B. (to Dept. of Energy, Washington, DC). US Patent 4,761,302. 2 Aug 1988. Filed date 1 May 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A process for incorporating fluorine into amorphous thin-film material is described comprising depositing amorphous thin-film material onto a substrate. The amorphous material is selected from the group consisting of silicon, germanium, or mixtures thereof, and introducing XeF/sub 2/ during the thin-film deposition process to incorporate and intimately intermix fluorine into the thin-film material.

51719 **Formation of MOS gates by rapid thermal/microwave remote-plasma multiprocessing.** Moslehi, M.M.; Saraswat, K.C. (Center for Integrated Systems, Stanford Univ., Stanford, CA (US)). *IEEE Electron Device Letters;* **EDL-8**: No. 9, 421-424(Sep 1987).

A novel cold-wall single-wafer lamp-heated rapid thermal/microwave remote-plasma multiprocessing (RTMRPM) reactor has been developed for multilayer in-situ growth and deposition of dielectrics, silicon, and metals. This equipment is the result of an attempt to enhance semiconductor processing equipment versatility, to improve process reproducibility and uniformity, to increase growth and deposition rates at reduced processing temperatures, and to achieve in-situ processing. For high-performance MOS VLSI applications, a variety of selective and nonselective tungsten deposition processes were investigated in this work. The tungsten-gate MOS devices fabricated using the remote-plasma multiprocessing techniques exhibited negligible plasma damage and near-ideal electrical characteristics. The flexibility of the reactor allows independent optimization of each process step yet permits multiprocessing.

51720 **High temperature oxidation and corrosion of metal-silicides.** Meier, G.H. (Univ. of Pittsburgh, Pittsburgh, PA (US)). pp 443-458 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The high temperature oxidation of metal silicides is briefly reviewed followed by a description of recent experiments on the oxidation and mixed oxidant corrosion of Ni- and Fe-silicides. The oxidation kinetics are related to the structure and composition of the oxide films formed under various exposure conditions. Finally, the effects of pre-formed SiO/sub 2/ films on minimizing the corrosion of Ni- and Fe-base alloys in sulfur-bearing gases are presented.

40 CHEMISTRY

51721 **(PSI—8) Progress report 1986/87 of the chemistry department.** Gaeggeler, H. (ed.). (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)). May 1988. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703471/JAW.

The following fields of activity are described: SAPHIR gas-jet; experiments for chemistry of Zr and Nb; continuous aerosol measurement by the epiphaniometer; determination of fractal structural parameters of aerosol particles; sorption and desorption of barium on glaciofluvial loose rock; cyclic behavior of metals in ground water; radon at infiltration of river water into ground water - a new method for measurement of ground water flow velocity; the borehole dilution method with bromine-82 for determination of ground water flow velocity; determination of sedimentation rates in Lake of Constance with lead-210 and cesium-137; macro- and microelements in the system spruce/ground/aerosol; the ground as support of the tree; experiments for chemistry of lawrencium; determination of excitation functions for nobelium isotopes from the fusion reaction /sup 48/Ca + /sup 208/Pb; determination of half life for the spontaneous fission of /sup 254/No; the nitrogen fixation potential of agriculturally used legumes; Chernobyl-fallout measurements on size-fractional aerosols; deposition of /sup 134,137/Cs from the Chernobyl-fallout on spruce needles and its incorporation in the needles; Chernobyl-fallout in the Swiss Alps; ion chromatography on fog samples. 64 refs., 53 figs., 4 tabs.

51722 **(RISO-M—2700) Annual report 1987 Chemistry Department.** Funck, J.; Larsen, E.; Nielsen, O.J. (eds.). (Risoe National Lab., Roskilde (Denmark)). Apr 1988. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754488/JAW.

This report contains a brief survey of the main activities in the Chemistry Department. The names and abstracts of all articles and reports published and lectures given in 1987 are presented. The facilities and equipment are mentioned briefly. The activities are divided into the following groups: radioisotope chemistry, analytical- and organic chemistry, environmental chemistry, polymer chemistry, radical chemistry, mineral processing, and general. 13 ills.,

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 50740, 50747, 50748, 50841, 50871, 50872, 50873, 50880, 50904, 51573, 51589, 51634, 51676, 51793, 51794, 51930, 51956, 51957, 52042, 52043, 52098, 52157, 52158, 52197, 52217, 52261, 52263, 52416, 52425, 52427, 52430, 52500, 52613, 52761, 52787, 52896

51723 **(BARC—1389) Analytical Chemistry Division: annual report (for) 1986.** Krishnamoorthy, T.S.; Mahadevan, N. (eds.) (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704081/JAW.

The Research and Development (R and D) activities of the Analytical Chemistry Division of the Bhabha Atomic Research Centre, Bombay, during 1986 are reported in the form of individual summaries. Analytical consultancies to outside organisations are also described in brief. Information regarding number of samples analysed, publications, invited talks, award of research degrees, training imparted to scientists from R and D organisations in the country and abroad etc. is given in the appendices at the end of the report. (M.G.B.).

51724 **(CNIC—00100) Voltammetry determination of the uranyl ion after its preconcentration on a trioctylphosphine oxidecoating glassy carbon electrode.** Zhao Guifang. (Southwest Inst. of Nuclear Reactor Engineering, Leshan, SC (China)). (China Nuclear Information Centre, Beijing, BJ). Nov 1987. 6p. (In Chinese). (SINRE—0006). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704098/JAW.

A glassy carbon (GC) electrode is used for the voltammetry determination of trace uranyl ion in the liquid wastes from the uranium chemical process. Prior to determination, the uranyl ion is preconcentrated on a TOPO-layer in the electrode. To obtain a TOPO-coated electrode, 2.5 μL of TOPO-ethanol solution (1.5 x 10/sup -2/ mol/L) is added to the GC disk (7 mm in diameter) and fused by infrared. The electrode can effectively concentrate uranyl ion from the solution (0.25 mol/L of KNO/sub 3/ at pH = 3.4) in a condition of open circuit. The concentrated uranyl ion gives a reduction wave at about-0.35 V vs. SCE. The peak height of the wave is dependant on the concentration of uranyl ion in a aqueous solution. This method is fairly selective to the uranyl ion because the TOPO-layer electrochemically masks some ions which give reduction waves at a GC electrode without a TOPO-coating. The method is active and simple and convenient.

51725 **(CONF-8809106—2) Gas sensor arrays for olfactory analysis: Issues and opportunities.** Hoffheins, B.S.; Lauf, R.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013839/JAW.

From Sensors Expo; Chicago, IL, USA (13 Sep 1988).

There have been many approaches to the development of gas sensor arrays for use in gas detection instruments and devices. Various techniques have been proposed to handle the signal processing and pattern recognition required to convert the outputs of these arrays into useful information such as the identities and concentrations of particular chemical species. In general, the pattern recognition techniques have not been developed as fully as have the sensor arrays. Materials issues, like sensor aging and drift, power requirements, and packaging are also problems that must be solved before gas sensor arrays can be incorporated into instruments for industrial and consumer markets. This paper describes significant thrusts in the areas of metal-oxide gas sensor array design and construction, related signature analysis and deconvolution, and materials issues. Recommendations are offered for future developments.

51726 **(DOE/ER/13281—2) Novel approaches to ionic chromatography: Progress report.** Dasgupta, P.K. (Texas Tech Univ., Lubbock (USA). Dept. of Chemistry and Biochemistry). 1988. Contract FG05-84ER13281. 7p. NTIS, PC A02/MF A01. Order Number DE88017068/JAW.

In the area of membrane-suppressed anion chromatography, new membranes, some produced in our laboratory, others custom made for us by Perma-Pure Products, all in tubular form, have been utilized to design and build devices of unprecedented transport characteristics. We are now able to quantitatively exchange 500 μeq NaOH/min (0.5 M NaOH flowing at 1 mL/min) without any observable band dispersion with the best available commercial columns. Because of these considerably superior membrane characteristics, we have returned to the simple, low-pressure drop, single membrane, filament-filled helix designs. We are able to prepare asymmetric membranes by coating a porous inert tubular membrane (e.g., made of polypropylene, Celgard {times} 2400) in diameters of 100-400 μm with 5-25 μm coating of an ion exchanger, e.g., Nafion or a nonporous permselective material, e.g., silicone rubber. The coating is applied from solution and can be recoated repeatedly to achieve essentially any desired thickness. These tubes have the structural strength of the base material (burst strength ≧400 psi) and transport characteristics of the thin deposited layer and as such, are bound to see use in a variety of areas. When using very thin active-layer membrane based suppressor in IC, regenerant penetration becomes a significant problem. This has been solved by using carefully purified poly(styrene sulfonic acid) as regenerant which is continuously recirculated through a large bed exchanger. The latter is periodically replaced or regenerated off-line. The silicone-coated membranes have allowed us to essentially completely remove CO_2 from carbonate-based eluents, operating under significant pressure at room-temperature.

51727 **(DOE/EV/06022—T1) Development of laser-excited molecular luminescence spectrometric methods for polycyclic aromatic hydrocarbons in environmental sciences: Progress report period March 1, 1985--September 30, 1987.** Winefordner, J.D. (Florida Univ., Gainesville (USA). Dept. of Chemistry). [1988]. Contract AS05-78EV06022. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016266/JAW.

This progress report in Laser-excited molecular luminescence spectrometric methods for polycyclic aromatic hydrocarbons covers: epifluorescence microscopy; room temperature phosphorimetry; high sensitivity laser fluorometer; low pass filters for signal averaging; lock-in amplifier models; boxcar intergrator/averager models; fluorescence detection; and laser excited fluorescence of thermally vaporized polyaromatic hydrocarbons. 16 refs., 8 figs., 3 tabs.

51728 (INIS-mf—11309, pp 133-134) **Volume selective spectroscopy. In combination with water line suppression, spectral editing and post-detection signal processing (VOSING).** Knuettel, A.; Rommel, E.; Schnur, G.; Kimmich, R. (Ulm Univ. (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51729 (INIS-SU—15/A, pp 387-389) **Analysis of molybdenum, chromium, vanadium and iron by polarographic techniques.** Al-Zand, T.K. (Iraqi Atomic Energy Commission, Twaitha, Baghdad, IRAQ). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The application of direct current Tast polarograph, differential pulse polarography and phase-selective alternative current Tast polarography to the problem of determining molybdenum, chromium, vanadium and iron in various supporting electrolytes is reported. The effect of the supporting electrolyte on the wave/peak potential and sensitivity of the metal ion have been examined. The polarographic methods were applied for simultaneous determination of chromium (3)/chromium (6), vanadium (4), vanadium (5) and iron (2)/iron (3) in different supporting electrolytes. 1 fig.; 1 tab.

51730 **(INIS-SU—15/A) 37. Meeting. V. 3. Extended abstracts.** (International Society of Electrochemistry). 1986. 611p. (CONF-8608152—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW.

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Individual papers in scoep were processed separately.

51731 **(JINR—18-87-648) Distribution of elements during coal combustion process.** Sodnom, N.; Gehrbish, Sh.; Maslov, O.D.; Gavrilov, K.A.; Fiderkevich, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703337/JAW.

Submitted to the journal Khim. Tverd. Tela.

The distribution of elements during the process of coal combustion in parts of experimental apparatus has been studied and the concentrations of elements in coal, bottom ash and fly ash from Power Plants have been determined by instrumental photon activation analysis. The fly ash, enriched with Cu, Zn, As, I, Pb, Tl retained by filter and the bottom ash contained Sb, Ni, Cr, Mo, are collected at 90 deg C. In fly ashes Mo, Sb, I, Pb have been determined, there are the concentrations of these elements in coal lower than the detection limit. 10 refs.; 2 figs.; 3 tabs.

51732 **(JINR—18-87-649) Instrumental activation method for determination of chlorine in coal.** Sodnom, N.; Gehrbish, Sh.; Maslov, O.D.; Gavrilov, K.A.; Belov, A.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703338/JAW.

Submitted to the journal Isotopenpraxis.

An instrumental activation method for determining the chlorine content in coal using bremsstrahlung and photoneutrons from a microtron and a /sup 252/Cf source is described. Yields from the / sup 35/Cl(γ, n)/sup 34m/Cl reaction have been determined in the range of electron energies of 14-21 MeV. The limit of detection for chlorine in coal has been found to be 5x10/sup -4/% in gamma activation analysis and 0.2% in the case of /sup 252/Cf source with a neutron flux of 5x10/sup 7/ ns/sup -1/. 10 refs.; 2 figs.; 2 tabs.

51733 (KURRI-TR—291, pp 12-15) **High-temperature surface-ionization ion source for the JAERI ISOL.** Ichikawa, Shin-ichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

A surface-ionization ion source is used for quantitative determination of /sup 121/Ba by means of the difference in ionization efficiency of elements. A study is also made on simultaneous mass/element separation of /sup 124/La. Measurement is made of the effects of the temperature of the ionizer on the overall ion collection (ionization + carrying) efficiency of Cs and Ba. At ionizer temperatures above 2200 K, the efficiency of Ba ionization from a tantalum recoil catcher is about six times as high as that from a graphite recoil catcher. Gamma-ray spectra are observed for A = 121 in a /sup 32/S + /sup 93/Nb reaction. The ratio of the gamma-ray intensity measured with the tantalum catcher to that with the graphite catcher is found to have relations with the ionization efficiency of /sup 124/Ba. These results lead to a conclusion that four peaks in the spectra result from gamma-rays associated with the decay of /sup 121/Ba. Another study is made for the application of oxide ions to mass separation. Thus an effort is made at the determination of /sup 124/La. The ionization potential of a metal oxide MO is lower than that of M. The ratio MO/sup +//M/sup +/ is rather high for La, Ce, Pr, etc. The ionization efficiency of these metal oxides depends on the partial pressure of oxygen in the ionizer and ionizer temperature. Based on these facts, investigation is made to separate /sup 124/Cs, /sup 124/Ba and /sup 124/La that are produced together in a heavy ion reaction. (Nogami, K.).

51734 **(NRCN—527) Fluorometric determination of uranium in urine following extraction with Aliquat-336.** Gavra, Z.; Lapid, J.; Givra, Y.; Hemi, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Apr 1988. 24p. (In Hebrew). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703463/JAW.

A fluorometric determination of uranium in urine following its extraction with Aliquat-336, is presented. The method is suitable for 1 to 20 μg U/l, the inaccuracy being +- 10%, and this sensitivity is about ten times higher than that of the direct one. Although this method takes 30 minutes longer than the direct one, it can serve as an alternative to the direct fluorometric technique for the determination of uranium in urine which does not satisfy the safety requirements. (Auth.).

51735 **(NUCLEBRAS-CDTN—551) Determination of sulfur in solids by constant current coulometric titration following combustion.** Monteiro, R.P.G. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703465/JAW.

A method for determination of sulfur in solid materials by combustion in induction furnace, followed by constant current coulometric titration of the sulfur dioxide produced, is described. The method is applicable to samples with sulfur contents of 80 ppm to 20,000 ppm. Its feasibility was checked on the NBS and Leco steel samples. The results are in good agreement with the specified values.

51736 **(PNL-SA—15741) Applications of SFC-MS to toxins and compounds of biological interest.** Udseth, H.R.; Kalinoski, H.T.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 4p. (CONF-8806199—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88014768/JAW.

From 36. annual conference on mass spectrometry and allied topics; San Francisco, CA, USA (6 Jun 1988).

The principal applications of supercritical fluid chromatography (SFC) are for compounds that are thermally labile, of low volatility, and of low to moderate polarity. Many compounds of biological and pharmaceutical interest are defined by these criteria. We have examined selected compounds of moderate to high molecular weight with biological activity. We have used the HFR interface with CO_2 as the mobile phase with from 2 to 5% modifier. One class of compounds potentially addressable by SFC-MS are cyclic peptides. These polar compounds require the use of polar fluid modifiers with CO_2 as the mobile phase. The ionic nature of the more hydrophilic portions of such polypeptides can sometimes be shielded, allowing solvation in supercritical fluid solvents. Cyclosporin A was successfully separated by SFC-MS using a microbore column using a 2% methanol modifier. The compound was also successfully separated with a capillary column. With the capillary column 2% 2-propanol was adequate, whereas with the microbore column more polar methanol was needed. The mass spectra were identical in both cases. We also analyzed the sodium salt of two ionic polyethers, digitoxigenin, digoxigenin, and cymarin. Results are briefly discussed. 5 refs.

51737 **Plutonium from atmospheric weapons testing: fission track analysis of urine samples.** Moorthy, A.R.; Schopfer, C.J.; Banerjee, S. (Brookhaven National Lab., Upton, NY (USA)). *Analytical Chemistry;* 60: No. 14, 857A-860A(15 Jul 1988). Contract AC02-76CH00016.

Anant R. Moorthy and co-workers of Brookhaven National Laboratory describe methodology developed for the determination of trace amounts of ^{239}Pu in urine samples using fission track analysis.

51738 **Computer-controlled flow injection analysis system for on-line determination of distribution ratios.** Nekimken, H.L.; Smith, B.F.; Jarvinen, G.D.; Peterson, E.J.; Jones, M.M. (Los Alamos National Lab., NM (USA)). *Analytical Chemistry;* 60: No. 14, 1390-1393(15 Jul 1988).

An automated flow injection analysis (FIA) system has been developed for the rapid acquisition of liquid/liquid, metal ion distribution ratios (D). The system features automatic switching between aqueous metal sample and wash solutions, on-line solvent extraction, phase separation, and the simultaneous detection of the separated phases by diode-array spectrophotometry. A comparative study of manual, single-stage liquid/liquid extractions with the flow injection system was completed by using a new extraction system UO_2^{2+}/benzene/TOPO (trioctylphosphine oxide)/HBMPPT (4-benzoyl-2,4-dihydro-5-methyl-2-phenyl-3H-pyrazol-3-thione). The batch and FIA methods yielded results generally within 5% of each other. The major differences between the two systems are that the FIA system is at least twice as fast, is less labor intensive, is more reproducible, and yields better statistics (a result of the FIA's speed and automation features). Slope analysis of the plotted data from the uranyl extraction studies indicates that the extraction complex is $UO_2(BMPPT)_2(TOPO)$.

51739 **Characterization of multicomponent mixtures of polynuclear aromatic hydrocarbons with α-cyclodextrin-induced solid-surface room-temperature luminescence.** Bello, J.M.; Hurtubise, R.J. (Univ. of Wyoming, Laramie (USA)). *Analytical Chemistry;* 60: No. 13, 1285-1290(1 Jul 1988). Contract FG02-86ER13547.

α-cyclodextrin-induced solid-surface room-temperature luminescence (CISS-RTL) was used to characterize synthetic mixtures of polynuclear aromatic hydrocarbons (PAH) adsorbed on α-cyclodextrin-sodium chloride mixtures. With CISS-RTL, qualitative analysis of binary mixtures of benzo[a]pyrene and benzo[e]pyrene was easily accomplished even at nanogram levels. In addition, a technique was also developed that was used in characterizing a nine-component PAH mixture. This method employs extraction, selective excitation, and detection by CISS-RTL and solution fluorescence spectroscopy. Nine PAH of various sizes ranging from a two-ring compound (naphthalene) to a ten-ring compound (decacyclene) were selected as model compounds, and several synthetic mixtures containing different amounts of the nine PAH were prepared and were analyzed by this approach. The results showed that between seven to nine PAH were identified in the mixtures at nanogram levels.

51740 **Near-real time infrared observations of acidic sulfates in clean air at Mauna Loa, Hawaii.** Johnson, S.A.; Kumar, R. (Argonne National Lab., IL (USA)). pp 157-160 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Sulfuric acid and its partially or completely neutralized salts with ammonia are believed to result from the oxidation of sulfur dioxide in cloud water and in other heterogeneous media present in the atmosphere. Due to the natural abundance of ammonia and the

ubiquitous presence of sulfur in the atmosphere, $(NH_4)_2SO_4$ is commonly the dominant chemical species in the ambient aerosol. Episodic occurrences of acidic ammonium sulfates have been observed in urban as well as in regional environments. The amounts of ammonium sulfates are expected to be very low in areas far removed from anthropogenic emissions of sulfur dioxide. The chemical composition of submicrometer aerosol particles was determined at one such background site, the Mauna Loa Observatory (MLO) on Mauna Loa in Hawaii during an eight-day period in August 1986. The MLO site was selected for this measurement because it is the only ground-based aerosol observatory in the remote Pacific Ocean that allows extended sampling of aerosols in the free troposphere. Located at an altitude of 3.4 km, MLO is typically well above the regional trade wind inversion. Aerosol population in nocturnal downslope flows are, therefore, frequently representative of free tropospheric aerosols near the MLO altitude. The daytime upslope winds, on the other hand, carry the valley aerosol to the sampling site.

51741 **Aerosol nitrate and sulfate: measurements by three different co-located samplers.** Johnson, S.A.; Kumar, R. (Argonne National Lab., IL (USA)). pp 161-165 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Nitrates and sulfates are the dominant chemical species in atmospheric aerosols that are responsible for the dry deposition of acidity from the atmosphere. These ambient nitrates and sulfates are nitric acid and sulfuric acid, and their partially or completely neutralized salts with ammonia. The concentrations of these aerosol species are generally determined by collecting filter samples, typically over periods of 24 hours or longer. However, the chemical composition of the aerosol may change significant on a much shorter time scale. For example, the occurrence of acidic sulfates has been observed to be episodic in nature, such episodes typically lasting only a few hours. Nitric acid and ammonium nitrate are relatively volatile species. When filter samples are collected over long periods, the nitrates in the sample are more likely to be a reflection of the ambient aerosol at or near the end of the sampling period than of the integrated aerosol during the entire sampling period. Thus if the occurrence of nitrate is also episodic, the 24-hour filter samples may either miss such episodes if they occur early in the sampling period, or highlight them if they occur at the end of the sampling period. It is therefore important to examine the aerosol with a much finer time resolution than samples over 24 hours or more.

51742 **Physical and chemical alteration of marble and limestone samples in the acidic outdoor environment.** Youngdahl, C.A.; Sciammarella, C.A.; Williams, F.L.; Huff, E.A. (Argonne National Lab., IL (USA)). pp 182-183 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Marble and limestone briquette samples (each weighing 0.7-0.9 kg, with an upper surface area of 62 sq. cm) have been exposed since 1984 to both anthropogenic acid deposition from the environment and natural weathering at four field sites instrumented to record environmental data. At each of the sites, located near Raleigh, NC, Chester, NJ, Newcomb, NY, and in Washington, DC, 72 briquettes of each stone type were exposed in racks inclined 30° from the horizontal toward the south. Similar tests of the stone materials were initiated at a fifth site, in Steubenville, OH, in 1986; sheltered samples that receive clean rain in volumes equivalent to ambient rain were added to that site in 1987. The effects of the environment on the briquettes and other materials exposed at the sites have been assessed periodically by investigators from several US agencies cooperating in the National Acid Precipitation Assessment Program. Tests conducted by Argonne National Laboratory for the stone exposure program during the first three years of sample exposure included measurements of material loss and chemical analyses of stone alteration. Material loss was monitored by periodic weighings of briquettes dried after exposure and by a sensitive laser-moire method applied to surfaces of specially designed specimens. Chemical alteration was detected by analyses for sulfates, nitrates, chlorides, and fluorides, and for a series of metal cations, in sequential layers of stone removed from samples after field exposure.

51743 **Emissions uncertainties: implications for analysis of acid rain issues.** Chun, K.C.; Hanson, D.A.; Bassett, G.W.; Trexler, E.C. (Argonne National Lab, IL (USA)). pp 191 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—). Contract W-31-109-ENG-38.

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Emissions data used in the analysis of acid rain issues are usually estimated values with a certain degree of uncertainty. However, the degree of uncertainty can be reduced substantially if real-time emissions data are measured at large electric utility units and major nonutility emission sources. Emissions at a given aggregation level and a given time period may be estimated by multiplying emissions-estimation parameters (EEPs), i.e., emission factors, total activity levels, and emission control system penetration factors (one minus the control efficiency). Such estimates may be summed to obtain an estimate of emissions for a larger area and/or a longer period, or disaggregated to obtain an estimate of emissions for a smaller area and/or a shorter time period by multiplying by spatial and/or temporal allocations factors. Uncertainties in emission estimates, which are due to the uncertainties associated with the EEPs, can vary considerably with the size of the geographical area or the time interval, because aggregation reduces the uncertainty of the resulting emission estimates while disaggregation increases it. Uncertainty in EEPs consists of (1) random errors due to variability in the data from which the EEP values are derived and (2) systematic errors due to biases that occur in the measurement process and nonrepresentative sampling and from the use of nonrepresentative values of variables in EEP models. Biases can also occur from the use of an estimator, which is a formula to obtain estimates of emissions or EEP values. This paper describes the procedures for developing uncertainty values for various EEPs in terms of confidence intervals, considering both the data variability and biases.

51744 **Performance of biological denitrification fluidized bed reactors.** Benear, A.K.; Lahoda, E.J. (Westinghouse Materials Co., Cincinnati, OH (USA)). pp 259 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

A fluidized bed biodenitrification (BDN) facility was constructed at the Feed Materials Production Center (FMPC), a Department of Energy owned and contractor operated uranium production plant. The two-column BDN unit began continuous operation in May 1987, removing an average 435 kg/day of nitrate and nitrite, both as nitrogen. A demonstration of the technology was completed in July 1987, and the unit has operated since that time meeting the requirements for nitrate discharges. The facility currently operates with temporary power, controls, and winterization materials. This paper presents denitrification rates and effluent quality data for the winter months of 1987-1988. A comparison of this data to that reported in the technology demonstration period is also presented.

51745 **Laser excited fluorescence studies of black liquor.** Horvath, J.J.; Semerjian, H.G. (Center for Chemical Engineering, National Bureau of Standards, Gaithersburg, MD (US)). pp 258-264 of Optical techniques for industrial inspection. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

Laser excited fluorescence of black liquor was investigated as a possible monitoring technique for pulping processes. A nitrogen pumped dye laser was used to examine the fluorescence spectrum of black liquor solutions. Various excitation wavelengths were

used between 290 and 403 nm. Black liquor fluorescence spectra were found to vary with both excitation wavelength and black liquor concentration. Laser excited fluorescence was found to be a sensitive technique for measurement of black liquor with good detection limits and linear response over a large dynamic range.

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51746 (BMI/ONWI/C—37) Solubilities and stabilities of zirconium species in aqueous solutions: Literature review. Rizkalla, E.N.; Choppin, G.R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation; Florida State Univ., Tallahassee (USA). Dept. of Chemistry). [1988]. Contract AC02-87CH10290. 35p. OSTI, PO Bx 62, Oak Ridge, TN 3783103. Order Number TI88013295/JAW.

This document describes specific chemical properties of zirconium compounds in water. The information sources were published reports rather than experimental data. The information is reviewed as a comprehensive, descriptive report. Included as a supplement is a proposal for funding to study carbon-14 in the Palo Duro Basin repository. 17 refs., 4 figs., 6 tabs. (TEM)

51747 (CEA-R—5449) Benefits of microgravity for measurement of thermo-transport coefficients in liquid metal alloys. Praizey, J.P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). May 1988. 50p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754948/JAW.

After giving a brief review of thermo-transport principles, this paper describes the experimental technique used and presents the results obtained on the ground. The author determines the solutal stability conditions to be satisfied by the metal alloy so that ground thermotransport measurements are not disturbed by convection effects. The benefits of microgravity when such conditions cannot be achieved are demonstrated and the results obtained on pure Sn (isotope separation), Sn-Co, Sn-Ag and Sn-Bi during Spacelab missions in 1983 and 1985 are presented. The results of experiments carried out without the disturbing effect of convection are compared with those found in literature (experiments or calculations carried out from liquid structure models).

51748 (DOE/ER/01198—T32) Effect of pressure on the charge-transfer band of the $[Fe(CN)_6]^{4-}$-dimethyl viologen ion pair. Hammack, W.S.; Drickamer, H.G.; Hendrickson, D.N. (Illinois Univ., Urbana (USA). School of Chemical Sciences). [1988]. Contract AC02-76ER01198. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88014841/JAW.

The effect of pressure on the optical charge-transfer (CT) band of the ion pair $[Fe(CN)_6]^{4-}${center←dot}DMV^{2+} (DMV = dimethyl viologen) has been studied in aqueous solution. The most significant effects of pressure were twofold: (1) In the pressure range 0.001 to 10.0 kbar (1 kbar = 986.92 atm = 0.1 GPa) the CT band maximum shifted to higher energy by {approximately}1700 cm^{-1}. (2) In this same pressure range the integrated intensity of the CT band increased by {approximately}35%. There were no changes in the peak's full-width at half maximum (FWHM). Qualitatively, these phenomena are in accord with a vibronic coupling model used to describe mixed-valence metal compounds and also with a general theory of absorption spectra of ions in solution, as well as with Mulliken's theory of charge transfer. We also noted that the oscillator strength of the CT band decreased by over a factor of 2 at ambient pressure with increasing concentration of the ion pair (from 1.0 to 50 mM). This change correlates with the change of the ionic strength over the same concentration range. 28 refs., 3 figs.

51749 (DOE/ER/13276—4) Characterization of catalysts with metal-support effects and of the species adsorbed on their surfaces: Final progress report, September 1, 1984--August 30, 1988. Vannice, M.A. (Pennsylvania State Univ., University Park (USA). Dept. of Chemical Engineering). Aug 1988. Contract FG02-84ER13276. 11p. NTIS, PC A03. Order Number DE88016900/JAW.

The principal objectives of our research were: "to gain a better understanding of the chemistry and physics which produce these metal-support effects and, as a consequence, to use this information to quide us in the development of new and improved catalyst systems for particular reactions." We chose to do this by investigating Pt and Pd dispersed on selected supports using a multifaceted approach involving DSC, TGA, NMR, adsorption, and kinetic studies of selected probe reactions. This approach has led us to the preparation of: 1) the most active Pd catalysts to date for benzene hydrogenation; 2) the most active Pt catalysts to date (by more than an order of magnitude) for acetone hydrogenation to isopropanol; and 3) the only Pt catalysts capable of significant selectivity to crotyl alcohol during crotonaldehyde hydrogenation. Calorimetric studies using DSC have shown that the principal reason for decreased chemisorption capacity on TiO_2-supported Pt and Pd is the physical blockage of metal surface by TiO/sub x/ species rather than by a large decrease in the heats of adsorption, Q/sub ad/. Also, with Pd a large crystallite size effect was found which increased Q/sub ad/ values on particles smaller than 3 nm. Each of these aspects will be addressed. 15 refs., 4 figs.

51750 (DOE/ER/13615—2) Catalytic hydrogenation of carbon monoxide: Research progress report, September 15, 1987--September 14, 1988. Wayland, B.B. (Pennsylvania Univ., Philadelphia (USA). Board of Trustees). 1988. Contract FG02-86ER13615. 7p. NTIS, PC A02/MF A01. Order Number DE88017098/JAW.

This project is focused on developing strategies to accomplish the hydrogenation of carbon monoxide to produce organic oxygenates at mild conditions. Our approaches to this issue are based upon the recognition that rhodium macrocycles have unusually favorable thermodynamic values for producting a series of metallo intermediates implicated in the catalytic hydrogenation of CO. Thermodynamic and kinetic-mechanistic studies are used in constructing energy profiles for metal promoted conversion of H_2 and CO to oxygenates, and these schemes are used in guiding the design of new metallospecies that could improve the thermodynamic and kinetic factors for individual steps in the overall process. Variation of the electronic and steric effects associated with the lignad arrays along with the influences of the reaction medium provide the chemical tools for tuning these factors. We have successfully used this general approach to establish thermodynamic criteria for metal promoted reductive coupling of carbon monoxide, which resulted in our recent observation that rhodium porphyrins can accomplish this important reaction. Current studies are directed toward the use of non-macrocyclic ligand complexes that emulate the favorable thermodynamic features associated with rhodium macrocycles, but that also manifest improved reaction kinetics.

51751 (DOE/FC/10619—2518) Degradation of polycyclic aromatic hydrocarbon compounds under various redox conditions in soil-water systems: Quarterly report, October 1987. Mihelcic, J.R.; Luthy, R.G. (Carnegie Inst. of Tech., Pittsburgh, PA (USA). Dept. of Civil Engineering). Oct 1987. Contract AC21-84FC10619. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016843/JAW.

This study evaluated microbial degradation of naphthol, naphthalene, and acenaphthene under aerobic, strict anaerobic, and denitrification conditions in soil-water systems. Chemical degradation of naphthol and naphthalene in the presence of a manganese oxide was also studied. Naphthol, naphthalene, and acenaphthene were degraded microbially under aerobic conditions from initial aqueous phase concentrations of 9, 7, and 1 mg/l to nondetectable levels in 3, 10, and 10 days respectively. Under anaerobic conditions naphthol degraded to nondetectable levels in 15 days while naphthalene and acenaphthene showed no significant degradation over time periods of 50 and 70 days respectively. Under denitrification conditions naphthol, naphthalene, and acenaphthene were de-

graded from initial aqueous phase concentrations of 8, 7, and 0.4 mg/l to nondetectable levels in 16, 45, and 40 days respectively. Acclimation periods of approximately 2 days under aerobic conditions, and 2 weeks under denitrification conditions, were observed for both naphthalene and acenaphthene. Abiotic degradation of naphthalene and naphthol were evaluated by reaction with manganese oxide, a minor soil constituent. In the presence of a manganese oxide naphthalene showed no abiotic degradation over a time period of nine weeks, while aqueous naphthol concentration decreased from 9 mg/l to nondetectable levels in 9 days. Results show that low molecular weight, unsubstitued polycyclic aromatic hydrocarbons are amendable to microbial degradation in soil-water systems under denitrification conditions. These type of compounds may otherwise persist in soil-water systems in the absence of nitrate and molecular oxygen, or a suitable substituent group on the aromatic ring. 27 refs., 10 figs.

51752 **(DOE/PC/79852—T1) Electro-catalytic reduction of nitrogen oxides: Topical report for May 17, 1987-June 30, 1988.** Someshwar, A.V. (New Hampshire Univ., Durham (USA). Dept. of Chemical Engineering). 12 Jul 1988. Contract AC22-87PC79852. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013028/JAW.

This study is aimed at investigating the use of intense electric fields and discharges resulting from the application of such fields to electrodes of small dimensions (such as points or wires) in conjunction with various material surfaces to bring about the reduction of nitric oxides without the aid of other reducing agents such as NH_3, CO, etc. Two important observations have been made with respect to the catalytic reduction of NO. The first concerns the inability of the oxygen released from the NO dissociation from leaving the adsorption surface, thus restricting the surface activity. The second relates to the following postulation. In order to explain the low rates of reduction, inspite of fairly low activation energies for NO dissociation over noble metal and transition metal oxide catalysts, the pre-exponential factor in the reaction rate constant must be small. Thus, the goal in this work is to look into possible ways of providing a high electronic density on the catalyst surface that might cause the predominant formation of NO^-, which would then dissociate more readily. In addition, the surface concentration of O^- ions can be controlled by suitable applications of electrostatic fields. If the NO^- dissociation led to O^- then it was felt that strong negative potentials at the surface would help in desorbing the O^- ions, thus maintaining the initial surface activity. 23 refs., 4 figs., 47 tabs.

51753 **(ECN—88-116) Simultaneous determination of C/sub 1/-C/sub 2/ aldehydes and organic acids in aqueous atmospheric samples by high-performance liquid chromatography.** Keuken, M.P.; Schoonebeek, C.A. (Netherlands Energy Research Foundation, Petten). Jul 1988. 21p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

A high-performance liquid chromatographic method for the simultaneous determination of C/sub 1/-C/sub 2/ aldehydes and organic acids in aqueous samples has been developed. Aldehydes and organic acids are separated after derivatization of the aldehydes by 2,4-dinitrophenylhydrazine and by gradient elution on reversed-phase material. Measurement is by UV and conductivity, respectively. The detection limits, using an injection volume of 100 ul, for formaldehyde, acetaldehyde, formic acid and acetic acid are 5 ug.l/sup -1/, 10 ug.l/sup -1/, 20 ug.l/sup -1/ and 30 ug.l/sup -1/, respectively. Aldehydes are stabilized by the derivatization reagent for a period of maximal five days in the field. Results of measurements of rain, mist and dew samples, collected in Petten (The Netherlands) indicate the presence of C/sub 1/-C/sub 2/ aldehydes and organic acids in the range from 0.01 to 3 mg.l/sup -1/. 6 figs., 42 refs., 2 tabs.

51754 (INIS-mf—11309, pp 153) **Optical purity studies on some dihydropyridinic compounds.** Marchioro, C.; Case, N.; Perchinunno, M.; Mica, R. (Glaxo Duncan Laboratories, Verona (Italy)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51755 (INIS-mf—11309, pp 88) **Carbon-13 and deuterium NMR studies on the liquid and solid phases of globular (CH/sub 3/)/sub 3/ CX compounds.** Aksnes, D.W.; Ramstad, K. (Bergen Univ. (Norway). Dept. of Chemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51756 (INIS-mf—11309, pp 169) **Determination of the / sup 1/H and /sup 13/C shielding and /sup 13/C-/sup 14/N spin-spin coupling anisotropies for methylisocyanide in liquid crystals.** Jokisaari, J.; Hiltunen, Y.; Lounila, J.; Pulkkinen, A. (Oulu Univ. (Finland). Dept. of Physics). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51757 (INIS-mf—11309, pp 167) **/sup 29/Si doublequantum coherence spectroscopy (INADEQUATE). A powerfull method for the structure elucidation of silicon frameworks.** Schrank, F.; Mitter, F.K.; Hengge, E. (Technische Univ., Graz (Austria)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51758 (INIS-mf—11309, pp 165) **Molecular dynamics of crown ethers.** Geringer, M.; Sterk, H. (Graz Univ. (Austria). Inst. fuer Organische Chemie). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51759 (INIS-mf—11309, pp 162-163) **Assignment of end-group resonances of polyamide-4,6.** Vries, N.K. de; Linssen, H.A.J.; Velden, G. van der. (DSM Research BV, Geleen (Netherlands)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51760 (INIS-mf—11309, pp 161) **Possible conformational dependence of long range deuterium isotope effects on C-13 chemical shifts.** Vikic-Topic, D.; Meic, Z. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51761 (INIS-mf—11309, pp 155) **Determination of the configuration and conformation of tetracyclic partly saturated benzoxazines by NMR.** Pelczer, I.; Dombi, G.; Lazar, L.; Fueloep, F.; Bernath, G. (Institute for Drug Research, Budapest (Hungary); Albert Szent-Gyoergyi Medical University Szeged, Institute of Pharmaceutical Chemistry, H-6720 Szeged (Hungary)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51762 (INIS-mf—11309, pp 142-143) **Enantiomerization barrier energy of N-isopropylsalicylaldiminate beryllium and zinc complexes.** Bottino, F.A.; Finocchiaro, P. (Catania Univ. (Italy)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51763 (INIS-mf—11309, pp 158-159) **Application of Cu(2,4-dichloro-benzoate)/sub 2/ as selective para-magnetic relaxation agent in the /sup 13/C NMR spectral analysis of N-heterocyclics.** Szalontai, G. (NEVIKI, H-8200 Veszprem (Hungary)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51764 (INIS-mf—11309, pp 157) **Computer-assisted structure elucidation of organic compounds. Automatic interpretation of /sup 13/C-NMR spectra.** Haas, P.; Blach, J.; Robien, W. (Vienna Univ. (Austria). Inst. fuer Organische Chemie). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51765 (INIS-mf—11309, pp 144) **/sup 139/La-NMR-spectroscopy: solution studies on triscyclo-pentadienyl-La(III)-derivatives.** Eggers, S.H.; Adam, M.; Haupt, E.T.K.; Fischer, R.D. (Hamburg Univ. (Germany, F.R.). Inst. fuer Anorganische und Angewandte Chemie). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51766 (INIS-mf—11309, pp 138) **Determination of partial structures of dissolved humic acids by one and two dimensional /sup 13/C NMR spectroscopy and by /sup 17/O NMR spectro-scopy.** Buddrus, J.; Burba, P.; Herzog, H.; Lambert, J. (Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51767 (INIS-mf—11309, pp 136-137) **Structurally new macrocycles from the resorcinol-aldehyde condensation reaction. Configurational and conformational analyses by means of dynamic NMR, NOE and T1 experiments.** Abis, L.; Dalcanale, E.; Du vosel, A.; Spera, S. (Instituto G. Donegani, Novara (Italy)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51768 (INIS-mf—11309, pp 152) **Carbon-13 relaxation in sucrose outside of the extreme narrowing region.** Kovacs, H.; Kowalewski, J. (Stockholm Univ. (Sweden). Dept. of Physical, Inorganic and Structural Chemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51769 (INIS-mf—11309, pp 115) **/sup 2/H and /sup 13/C NMR measurements of the molecular dynamics, morphology, and order in stiff macromolecules with liquid crystalline mesophases.** Whittaker, A.K.; Falk, U.; Adam, A.; Spiess, H.W. (Max-Planck-Institut fuer Polymerforschung, Mainz (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51770 (INIS-mf—11309, pp 113) **/sup 13/C CP-MAS NMR spectra of some aromatic sulfur amides.** Haekkinen, A.M.; Ruostesuo, P. (Helsinki Univ. Central Hospital (Finland). Meilahti Clinic; Oulu Univ. (Finland)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51771 (INIS-mf—11309, pp 107) **Deuteron 2D exchange NMR of solids.** Schmidt, C.; Bluemich, B.; Spiess, H.W. (Max-Planck-Institut fuer Polymerforschung, Mainz (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51772 (INIS-mf—11309, pp 106) **Phosphorous homonuclear correlation spectroscopy in the solid state.** Xiuwen, Han; Rueegger, H. (Spectrospin AG, Faellanden (Switzerland)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51773 (INIS-mf—11309, pp 104-105) **Field-cycling NMR study of collective molecular motions in smectic liquid crystals.** Pusiol, D.; Noack, F. (Stuttgart Univ. (Germany, F.R.). Physikalisches Inst.). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51774 (INIS-mf—11309, pp 96-97) **Paramagnetic shift probes in high-resolution solid state NMR.** Grey, C.P.; Dobson, C.M.; Cheetham, A.K.; Jakeman, R.J.B. (Oxford Univ. (UK). Inorganic Chemistry Lab.). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51775 (INIS-SU—15/A, pp 42-44) **Electrochemical reduction of molybdenum compounds in molten lithium chloride - potassium chloride eutectic.** Popov, B.; Slavkov, D.; Ivshin, J. (Belgrade Univ. (Yugoslavia). Tehnolosko-Metalurski Fakultet). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The mechanism of electrochemical reduction of MoO/sub 3/ in KCl-LiCl melt at 450 deg has been investigated by the chronopotentiometry method. Two reduction steps for MoO/sub 3/ were found at the quarter wave potentials - 0.35 V and - 1.75 V vs. a Pt reference electrode. It is shown that the first reduction step of MoO/sub 3/ corresponds to the reduction of MoO/sub 2/Cl/sub 2/ which is a diffusion controlled process. In order to account for chronopotentiometric data for the reduction step of MoO/sub 3/ in the presence of Li/sub 2/MoO/sub 4/, one must consider the existence of an acid-base equilibrium in the melt. 4 refs.; 3 figs.

51776 (INIS-SU—15/A, pp 179-181) **K/sub 2/UI/sub 6/ and Na/sub 2/UI/sub 6/ as solid electrolytes.** Szczepaniak, W. (Wroclaw Univ. (Poland)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Using DTA method phase diagrams of NaI-UI/sub 4/ and KI-UI/sub 4/ systems have been determined. Electric conductivities of the solid and liquid phases have been measured. 4 refs.; 3 figs.

51777 (INIS-SU—15/A, pp 182-185) **Electrochemical and thermal properties of the CdI/sub 2/-KI system.** Susic, M.V.; Pjescic, M.G.; Mentus, S.V. (Belgrade Univ. (Yugoslavia). Inst. za Fizicku Hemiju). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Electrochemical and thermal properties of the CdI/sub 2/-KI system have been studied. The dependence curves of logκ-1/t for different mol fractions of the components have been illustrated. It have been found that the CdI/sub 2/-KI mixture is in a solid state up to 436 K, as well as that it is a good ionic conductor in the temperature range 393-463 K. Out of the cyclic volammetric curves, taken for the given system, exchange current, electrolytic resistance and activation energy have been found. 6 refs.; 3 figs.

51778 (INIS-SU—16/A, pp 51-52) **Electrical and magnetic properties of n-alkylurotropinium-polyiodides.** Fuellbier, H.; Stegemann, H.; Schmidt, L.; Mittag, H.; Petrovskis, G.; Cikmacs, P.; Lusis, A. (Ernst-Moritz-Arndt-Universitaet, Greifswald (German Democratic Republic); Latvijskij Gosudarstvennyj Univ., Riga (USSR)). 1986. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88780186/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Alkylurotropinium polyiodides, UrRI/sub x/ with Ur=urotropine, x3 and R=C/sub n/H/sub 2n+1/ with $1 \geqq n \leqq 6$; x=5 and n=2; 3; 4; 6; x=7 and n=2; 3; 4 and (UrR)/sub 2/I/sub 8/ with n=1; 5 were chemically prepared by conversion of the corresponding monoiodides with aqueous solution of KI/sub 3/. The polyiodides were measured with ac- and dc-techniques. The electric conductivity of the polyiodides increases with increasing iodine contents (triiodides are insulators, penta- and heptaiodides are bad semiconductors). The magnetic susceptibility doesn't depend on the magnetic field strength and on temperature. 1 ref.; 1 tab.

51779 **(INIS-SU—16/A) 37. Meeting. V. 4. Extended abstracts.** (International Society of Electrochemistry). 1986. 508p. (CONF-8608152—). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88780186/JAW.

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Individual papers in scope are processed separately. (DLC)

51780 **(KFK—4410) Development of a method for calculating the equilibrium and kinetics of ion exchange on a weak acid resin in a ternary system H/sup +/-Ca/sup 2+/-Mg/sup 2+/.** Dolezych, W.; Horst, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). May 1988. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754672/JAW.

In technical applications ion exchange resins are applied in filters. The breakthrough behaviour of such filters can be calculated using mathematical relationships for equilibrium and kinetics. An according method has been developed for a ternary ion exchage problem on a weak acid resin. Theoretical results are verified by means of experimental data.

51781 **(NP—8770354) Interactions between hydrogen and Ni or Cu-Ni surfaces.** Chehab, F. (Hamburg Univ. (Germany, F.R.). Fachbereich 13 - Chemie). 11 Jul 1985. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770354/JAW.

The adsorption of hydrogen to the monocrystal surfaces Ni(111), Cu-Ni(111), Ni(110), and Cu-Ni(110) was investigated at 100 K to 400 K using the following methods: Auger electron spectroscopy (AES), low-energy electron diffraction (LEED), photoelectron spectroscopy (UPS and XPS), thermal desorption spectroscopy (TDS), and electron affinity changes (ΔPHI). The investigations provided information on the type and extent of hydrogen chemisorption, the influence of the surface geometry on the adsorption characteristics, the feedback effect on geometry of the adsorbate, and the modification of the adsorption characteristics of the pure nickel surfaces by alloying with copper. (orig/GG).

51782 **(UCRL—99324) Computer modeling of autoignition chemistry.** Westbrook, C.K.; Pitz, W.J. (Lawrence Livermore National Lab., CA (USA)). 25 Jul 1988. Contract W-7405-ENG-48. 51p. (CONF-8809117—1). NTIS, PC A04/MF A01. Order Number DE88015451/JAW.

From 2. international symposium on computation chemistry on cray computers; Chicago, IL, USA (11 Sep 1988).

The development of detailed chemical kinetic reaction mechanisms for analysis of autoignition and knocking of complex hydrocarbon fuels is described. The wide ranges of temperature and pressure which are encountered by end gases in automobile engine combustion chambers result in extreme demands on the reaction mechanisms intended to describe knocking conditions. The reactions and chemical species which are most important in each temperature and pressure regime are discussed, and the validation of these reaction mechanisms through comparison with idealized experimental results is described. The use of these mechanisms is illustrated through comparisons between computed results and experimental data obtained in actual knocking engines. 55 refs., 8 figs., 4 tabs.

51783 **Nonspectator electron processes in resonant Auger spectra of $SiCl_4$.** Carlson, T.A.; Mullins, D.R.; Beall, C.E.; Yates, B.W.; Taylor, J.W.; Grimm, F.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6201). *Journal of Chemical Physics;* **89**: No. 8, 4490-4493(15 Oct 1988).

Angle-resolved photoelectron spectroscopy has been carried out on the valence shell of $SiCl_4$ over the range of photon energies from 101.5 to 112.5 eV. Both intensities and angular distribution parameters β were monitored over the preionization resonances for silicon 2p. Little effect was seen for emission from the chlorine lone-pair orbitals $2t_1$, $8t_2$, and 2e, but striking effects were seen for the bonding $7t_2$ orbital. The resonant behavior was compared with photoabsorption data. The results are discussed in terms of direct participation of the resonantly excited electron and this process compared with spectator electron and shakeup processes.

51784 **Tunable far infrared laser spectroscopy of van der Waals bonds: Vibration—rotation—tunneling spectra of Ar—H_2O.** Cohen, R.C.; Busarow, K.L.; Laughlin, K.B.; Blake, G.A.; Havenith, M.; Lee, Y.T.; Saykally, R.J. (Department of Chemistry and Materials and Chemical Sciences Division, University of California and Lawrence Berkeley Laboratories, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 8, 4494-4504(15 Oct 1988).

The first high resolution spectra of a rare gas—H_2O cluster have been observed using a tunable far infrared laser to probe the vibration—rotation—tunneling levels of Ar—H_2O formed in a continuous planar supersonic jet. The high sensitivity of this spectrometer facilitated extensive measurements of two perpendicular subbands which are assigned to transitions from the ground state to the upper component of a hydrogen exchange tunneling doublet (c-type) at 21 cm^{-1}, and to ν/sub b/$_1$ = 1^+ (b-type) at 25 cm^{-1}, the lower tunneling component of a bending vibration which is perpendicular to the tunneling coordinate. The tunneling splitting is shown to be in the range 2.5—7 cm^{-1} and the lower tunneling component of the excited bending vibration lies between 39 and 43 cm^{-1} above the ground state of the complex. The experimentally determined center-of-mass separation (R/sub c.m./ = 3.75 A) and harmonic stretching force constant (k/sub s/ = 0.0134 mdyn/A) are compared to those of related first and second row hydrides. The large amplitude motions occurring within this complex make it difficult to establish its structure.

51785 **Shape-resonant and many-electron effects in the S 2p photoionization of SF_6.** Ferrett, T.A.; Lindle, D.W.; Heimann, P.A.; Piancastelli, M.N.; Kobrin, P.H.; Kerkhoff, H.G.; Becker, U.; Brewer, W.D.; Shirley, D.A. (Department of Chemistry, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 8, 4726-4736(15 Oct 1988).

The core-level photoexcitation and photoionization of SF_6 were studied in the vicinity of the resonances below and above the S 2p threshold. The decay channels of the S 2p→6a_1/sub g/ dis-

crete excitation were characterized, with decay leading mostly to valence-shell satellites. The S 2p continuum data show an oscillatory asymmetry parameter β(S 2p) near threshold that is virtually identical to β(Si 2p) in SiF_4. It also resembles: but differs from: theoretical curves for β(S 2p) in atomic sulfur and in SF_6. Data at the feature assigned as an e/sub g/ shape resonance indicate strong multielectron properties for this state, because a resonance in the S 2p satellite is observed at the same photon energy as the main-line resonance. We propose a unified model which generally includes configuration interaction both in the continuum-state manifold and between discrete doubly excited states and the continua, to explain this unexpected satellite behavior. Finally, the S(L/sub 2,3/VV) Auger electron asymmetry parameter shows no significant deviation from zero near the t_2/sub g/ and e/sub g/ shape resonances.

51786 **Anharmonic force fields of HOF and F_2O.** Thiel, W.; Scuseria, G.; Schaefer H.F. III; Allen, W.D. (Theoretische Chemie, Universitaet Wuppertal, 5600 Wuppertal 1, West Germany). *Journal of Chemical Physics;* **89**: No. 8, 4965-4975(15 Oct 1988).

Ab initio predictions at the SCF, CISD, and CCSD levels are reported for the title compounds using DZP and TZP basis sets. The calculated geometries, rotational constants, dipole moments, fundamental frequencies, isotopic frequency shifts, vibration—rotation interaction constants, centrifugal distortion constants, Coriolis coupling constants, and infrared band intensities are compared with experimental data (if available). The best agreement is usually found for the CCSD results. The experimentally derived cubic force field of F_2O is reproduced well by our results so that the predicted cubic and quartic force fields of HOF and the predicted quartic force field of F_2O are also expected to be realistic. On the basis of our theoretical anharmonic constants, a new interpretation is suggested for the anomalous isotopic frequency shift of ν_3 in HOF and DOF. Finally, an experimentally derived r/sub e/ structure with R(O—F) = 1.4356 A, r(O—H) = 0.9664 A, and α(H—O —F) = 97.72° is proposed for HOF on the basis of the TZP CCSD vibration—rotation interaction constants.

51787 **π bonded intermediates in alcohol oxidation: Orientations of allyloxy and propargyloxy on Ag(110) by near edge x-ray absorption fine structure.** Solomon, J.L.; Madix, R.J.; Stoehr, J. (Department of Chemical Engineering, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **89**: No. 8, 5316-5322(15 Oct 1988).

The orientation of allyl alcohol (CH_2 = $CHCH_2OH$), propargyl alcohol (CH 3/4 CCH_2OH), and their surface alkoxy groups has been examined on Ag(110) using near edge x-ray absorption fine structure (NEXAFS) measurements. The planes containing the π^* orbitals of allyl alcohol and its alkoxy species, allyloxy (CH_2 = $CHCH_2O$-), are tilted 26 +- 4° and 32 +- 5° from the surface normal, respectively. Allyl alcohol itself shows no azimuthal ordering, but the π^* orbital in allyloxy is azimuthally oriented 33 +- 15° from the close-packed direction ([11-bar0] azimuth). Propargyl alcohol is randomly oriented on the Ag(110) surface. Its alkoxy group, propargyloxy (CH 3/4 CCH_2O-), is strongly oriented with the triple bond axis parallel to the plane of the surface and directed along the [001] azimuth, perpendicular to the troughs. The position of the σ^* resonances indicate that no loss of the allylic hydrogen has occurred and that the double and triple bonds are slightly, but not significantly, perturbed from their normal gas phase bond lengths.

51788 **Chemisorption of hydrogen on the nickel (111) surface.** Yang, H.; Whitten, J.L. (Department of Chemistry, State University of New York at Stonv Brook, Stony Brook, New York 11794-3400). *Journal of Chemical Physics;* **89**: No. 8, 5329-5334(15 Oct 1988).

The chemisorption of atomic H on the [111] surface of Ni is treated by use of a many-electron embedding theory to describe the electronic bonding. The lattice is modeled as a 26-atom, three layer cluster which is extracted from a larger cluster by an orbital localization transformation. Ab initio valence orbital CI calculations carried out on a local surface region permit an accurate description of bonding at the surface. H atoms are found to bind strongly to the Ni(111) surface at threefold and bridge sites. Calculated H binding energies are in the range 2.50—2.66 eV, for optimized Ni—H bond lengths ranging from 1.81 to 1.87 A. Vibrational frequencies are in the range 1043—1183 cm^{-1}. The binding energy of H at an atop atom site is 1.94 eV. The work function increases by ~0.2 eV on H adsorption.

51789 **Determination of chemisorption geometries for complex molecules by using near-edge x-ray absorption fine structure: Ethylene on Ni(100).** Zaera, F.; Fischer, D.A.; Carr, R.G.; Gland, J.L. (Department of Chemistry, University of California, Riverside, California 92521). *Journal of Chemical Physics;* **89**: No. 8, 5335-5341(15 Oct 1988).

We have derived theoretical expressions for the incident beam angular dependence of the absorption cross section for ethylene chemisorbed on single crystal surfaces with linearly polarized light. The changes in the π and σ resonance intensities for C 1s near-edge x-ray absorption fine structure (NEXAFS) spectra can be related to the geometry of chemisorption relative to the surface. The derived equations have been used to analyze experimental data in order to determine the structure of chemisorbed ethylene on Ni(100). At low temperatures ethylene bonds with the molecular axis parallel to the surface but with the molecular plane tilted 50°. The geometry of vinyl fragments formed by annealing the crystal to 180 K was also determined. The C—C bond is bent 35° from the surface normal in this case, with the plane of the molecule tilted by 65°.

51790 **Non-Boltzmann rotational and inverted spin—orbit state distributions for laser-induced desorption of NO from Pt(111).** Richter, L.J.; Buntin, S.A.; Cavanagh, R.R.; King, D.S. (Center for Chemical Physics, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Chemical Physics;* **89**: No. 8, 5344-5345(15 Oct 1988).

The internal state distributions of NO desorbed from a Pt(111) surface by visible and near-visible laser radiation (355, 532, and 1064 nm) were measured by laser-induced fluorescence. Non-Boltzmann rotational state distributions and inverted spin—orbit populations were observed and both were found to be relatively insensitive to the desorption-laser wavelength. It is suggested that the internal state distributions arise from the charge exchange processes occuring during desorption via a short-lived negative-ion resonance intermediate.

51791 **Generalization of Nose's isothermal molecular dynamics.** Jellinek, J.; Berry, R.S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] A: General Physics;* **38**: No. 6, 3069-3072(15 Sep 1988).

A generalization is given of the method introduced by Nose for simulating isothermal behavior by molecular dynamics. An infinity of physically inequivalent choices for dynamics can be made to evaluate average properties of an equilibrated canonical ensemble. The availability of different choices may, we suggest, open the principal possibility of searching for a dynamics which will adequately mimic not only the equilibrium but also the time-dependent properties of a particular physical system.

51792 **Wigner-Seitz local-environment study of the high-T/sub c/ superconductors.** Melamud, M.; Bennett, L.H.; Watson, R.E. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 4624-4631(1 Sep 1988).

The near-neighbor environments and the bonding of atoms in the high-T/sub c/ superconductors are studied using a Wigner-Seitz-cell contruction. Assuming metallic radii for the atoms, it is shown that the Ba, Y, and La atoms have large coordination numbers, implying a three-dimensional bonding scheme. The La-Cu-O type (≃40 K) and the Y-Ba-Cu-O type (≃90 K) superconductors both display the same bonding characteristics.

51793 **Room temperature luminescence properties of benzo[f]quinoline and phenanthrene adsorbed on α-cyclodextrin-sodium chloride mixtures.** Bello, J.M.; Hurtubise, R.J. (Univ. of Wyoming, Laramie (USA)). *Analytical Chemistry;* **60**: No. 13, 1291-1296(1 Jul 1988). Contract FG02-86ER13547.

The room-temperature fluorescence (RTF) and room-temperature phosphorescence (RTP) intensities of benzo[f]quinoline (B[f]Q) and phenanthrene were obtained from several α-cyclodextrin-sodium chloride mixtures. The results showed the importance of the initial wet chemistry in the sample preparation procedures for the observation of luminescence signal for compounds adsorbed on α-cyclodextrin-sodium chloride mixtures. The data indicated that in order to obtain the optimum RTP and RTF signals, the solvent used to adsorb the analytes had to be saturated with α-cyclodextrin. Also, the solid-surface fluorescence and phosphorescence quantum yield, triplet formation efficiency, and phosphorescence lifetime values were obtained for B[f]Q and phenanthrene adsorbed on 0.05% and 80% α-cyclodextrin-sodium chloride mixtures. From these data, rate constants for phosphorescence and for radiationless transition from the triplet state were obtained.

51794 **Interferences in solid-phase extraction using C-18 bonded porous silica cartridges.** Junk, G.A.; Avery, M.J.; Richard, J.J. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* **60**: No. 13, 1347-1350(1 Jul 1988). Contract W-7405-ENG-82.

Procedural blanks from commercial solid-phase extraction (SPE) cartridges have been characterized. Alkanes, alkenes, plasticizers, and antioxidants were identified as possible interference compounds by extracting components of the cartridges and by analyzing these extracts by GC/MS. Most of the compounds identified in the extracts were also observed in the procedural blanks from use of the SPE cartridges.

51795 **Facile intramolecular coupling of alkyl and acyl ligands induced by Lewis acids: mechanistic studies on the formation of zirconium ketone complexes.** Waymouth, R.M.; Grubbs, R.H. (California Institute of Technology, Pasadena (USA)). *Organometallics;* **7**: No. 7, 1631-1635(Jul 1988).

Bis(cyclopentadienyl)zirconium acyl complexes $Cp_2Zr(X)COR$ (X = Cl, Me) react rapidly with alkylaluminum reagents R'_2AlY (Y = R', Cl) to give alkylaluminum adducts of zirconium ketone complexes $Cp_2Zr(\mu\text{-eta}^2\text{-OCRR'})(\mu\text{-Cl})AlR'_2$. Zirconium aldehyde complexes $Cp_2Zr(\mu\text{-eta}^2\text{-OC(H)R})(\mu\text{-Cl})AlR_2$ are prepared analogously by treating the acyl complexes with diisobutylaluminum hydride. Mechanistic investigations, including isotopic labeling and crossover experiments, indicate that aluminum reagents induce the intramolecular coupling of zirconium alkyl and acyl ligands to give ketone complexes.

51796 **Reaction of sulfur dioxide with (eta^5-C_5Me_5)Ru(CO)$_2$H: insertion of SO_2 into the Ru-H bond and oxygen transfer to form (eta^5-C_5Me_5)Ru(CO$_2$)SO$_3$H.** Kubat-Martin, K.A.; Kubas, G.J.; Ryan, R.R. (Los Alamos National Lab., TX (USA)). *Organometallics;* **7**: No. 7, 1657-1659(Jul 1988).

Any process that will convert SO_2 in stack gases to inoffensive products such as sulfur and water will be based on the reduction/oxygen transfer chemistry of SO_2. To better understand this chemistry, the authors have been investigating reactions of SO_2 with transition-metal hydride complexes. This work has now been extended to include the addition of $SO_2$to $Cp^*Ru(CO)_2H$(Cp^* = eta ^{5}-C_5Me_5).

51797 **Vibrated beds: New tools for heat transfer.** Thomas, B.; Liu, Y.A.; Mason, M.O.; Squires, A.M. (Virginia Polytechnic Institute and State Univ., Blacksburg, VA (US)). *Chemical Engineering Progress;* **84**: No. 6, 65-74(Jun 1988).

The mobility and porosity of a bed of granular solids, which is a few centimeters deep, can be increased by externally vibrating the bed vertically at frequencies usually between 10 and 100 Hertz (Hz). As an initially stationary bed is subjected to an increasing intensity of vibration, particles within the bed will eventually become mobile and a particle circulation pattern is developed within the bed. As the bed porosity increases, the bed may eventually become "fluid-like". In this work, beds of granular solids that are mobilized and transformed into a fluid-like state through the use of external mechanical vibrations alone are called vibrated beds; the method of producing this state is referred to as vibrofluidization.

51798 **Oxidation of methane in supercritical water.** Rofer, C.K.; Streit, G.E.; Avery, J.G.; Brewer, G.R.; Tester, J.W.; Webley, P.A. (Los Alamos National Lab., NM (USA)). pp 256-257 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Oxidation in supercritical water has been proposed as a method for destruction of hazardous organic chemical compounds. The objective of this work is to understand the mechanism for the oxidation of methane in supercritical water and to determine whether an essentially gas-phase kinetic mechanism can be used to model this oxidation process. A kinetics model based on gas-phase elementary reactions and rate constants is under development. Its predictions are being compared to the experimental data on methane oxidation. The model must be adapted to the supercritical water system by the use of available data, calculations, and estimates for certain rate constants under high pressure conditions, and certain additions must be made to the mechanism to account for the reactivity of water at supercritical conditions.

51799 **Reaction chemistry and thermodynamics of the Ni-Al and Fe-Al systems.** Santandrea, R.P.; Behrens, R.G.; King, M.A. (Los Alamos National Lab., Los Alamos, NM (US)). pp 467-472 of High-temperature ordered intermetallic alloys II. Stoloff, N.S.; Koch, C.C.; Liu, C.T.; Izumi, O. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The reaction chemistry of the Fe-Al and Ni-Al systems was studied using differential scanning calorimetry (DSC). Experimentally measured heats of reaction and compositions of reaction products were characterized in terms of sample heating rates, reaction temperature, shape and size of aluminum powder, and sample preparation. Standard enthalpies of formation were derived from DSC results. Reaction products were identified by x-ray powder diffraction techniques.

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REFER ALSO TO CITATION(S) 50841, 51666, 51674, 51729, 51730, 51752, 51797, 52493

51800 (AGF—8601, pp 213-219) **Electrochemical reduction of carbon dioxide.** Hori, Yoshio; Suzuki, Shin. (Chiba Univ., Faculty of Engineering, Chiba, Japan). 25 Nov 1986. (In Japanese). Asahi Glass Foundation for Industrial Technology, 2-2-1 Marunouchi, Chiyoda-ku, Tokyo.

In Reports of the Asahi Glass Foundation for Industrial Technology.

The elecrochemical reduction of CO_2 in aqueous electrolytes on various metal electrodes was studied. The findings are as follows: The product of electrochemical reduction greatly varies with the electrode metal. When a Au electrode is used, CO is generated; the product ratio between CO and H_2 is about 9. On a Cu electrode, the main product is CH_4; however, marked production of C_2H_4 is observed in some condition. The product also greatly varies with the temperature. At 40°C, the production of C_2H_4 is outstanding. (3 figs, 2 tabs, 26 refs)

51801 **(BNL—41558) Cyclic voltammetry at TCNQ and TTF-TCNQ modified platinum electrodes: A study of the glucose oxidase/glucose and galactose oxidase/galactose systems.** Hale, P.D.; Skotheim, T.A. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880669—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015820/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

Recent work has shown that the synthetic metal TTF-TCNQ can be used as an electrode material for the oxidation of enzymes containing the prosthetic group flavin adenine dinucleotide

(FAD). This direct electron transfer (direct in the sense that oxygen is not a mediator) between reduced enzyme and electrode, a process which does not occur to any measurable extent at a typical metal electrode, is not very well understood. In the present work, electron transfer between reduced glucose oxidase and TTF-TCNQ is investigated using cyclic voltammetry, and it is also shown that TCNQ itself can mediate this electron transfer between the enzyme and a platinum electrode. In addition to the glucose oxidase studies, cyclic voltammetric experiments have been performed on the galactose oxidase system, which contains a copper redox center rather than FAD. The results of these experiments demonstrate that the catalytic ability of TTF-TCNQ in enzyme-based electrochemical sensors is quite general. 15 refs., 4 figs.

51802 **(DOE/ER/13446—4) Mechanistic study of the effects of magnetic fields on scale formation: Progress report, September 1, 1987-August 30, 1988.** Katz, J.L. (Johns Hopkins Univ., Baltimore, MD (USA)). Aug 1988. Contract FG02-85ER13446. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016541/JAW.

This is the third in a series of progress reports describing research sponsored by the Division of Advanced Energy Projects of the US Department of Energy for the express purpose of: examining the fundamental physics and processes that must be occurring if magnetic water treatment is a real phenomenon, verifying whether magnetic fields can affect scale formation, at least under some circumstances; and, given verification of its existence, developing a sufficiently deep understanding of the relevant processes so that magnetic water treatment may be used successfully. The most common scale component is calcium carbonate ($CaCO_3$). $CaCO_3$ can occur in several crystalline forms -- calcite, aragonite, or vaterite. Calcite scale is particularly troublesome. The crystal masses tend to cement together and form very tenacious scale deposits. Aragonite, on the other hand, grows in loose bundles of long, needle-shaped crystals. Calcite is thermodynamically stable relative to aragonite, but aragonite often is the first phase to precipitate at elevated temperatures. Depending on the pH, the types of ions present, and the temperature, aragonite usually dissolves and recrystallizes into calcite over time. This recrystallization makes existing calcite scale deposits even more tenacious. We think it very unlikely that a magnetic field of only a few thousand gauss can affect Ca^{2+} and CO_3^{2-} ions directly since the interaction energies are too small compared to kT; however, an interaction via iron is plausible. We are now even more convinced that iron plays a critical role in magnetic water treatment. 23 refs., 19 figs.

51803 **(DOE/SF/00115—T13) Physical modeling of bubble phenomena, electrolyte flow and mass transfer in simulated advanced Hall cells: Progress report, April 15, 1988-July 31, 1988.** Evans, J.W. (California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Aug 1988. Contract AM03-76SF00115. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015585/JAW.

The objectives of this project are to define mathematically dimensionless numbers, using physical models and specialized apparatus and selected working fluids, to develop quantitative correlations of dimensionless groups, to recommend designs, and to predict advanced (low-energy) Hall-Heroult cell performance. Most of the important aspects of this project like the design of the near-vertical and the near-horizontal electrode configurations, and preliminary selection of the working fluid have been accomplished. Unfortunately, because of the problems associated with the tank which will house the electrode assembly, measurements in the physical model will be delayed by at least 2-3 weeks. 5 refs., 7 figs., 1 tab.

51804 (INIS-SU—11, pp 150-152) **Kinetics of anodic dissolution of rhenium in aqueous electrolyte solutions.** Atanasyants, A.G.; Kornienko, V.A. (Moskovskij Khimiko-Tekhnologicheskij Inst. (USSR)). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The kinetics of anodic rhenium dissolution was investigated by means of potentiodynamic and potentiostatic polarization curves recorded at temperature from 293 to 333 K in different media (NaOH, KOH, NaCl, NaBr, HCl, H/sub 2/SO/sub 4/) using the rotating disc technique. It is shown that the kinetics of anodic rhenium dissolution and effective activation energy depend not only on the composition and pH value of the solutions but also on the structure of the dissolving rhenium surface. The investigation of the anodic behaviour of the rhenium monocrystal revealed the existence of anisotropy of the monocrystal electrochemical properties. The experimental results point to an important role of adsorption processes in anodic rhenium dissolution. Rhenium dissolution proceeds with formation of intermediate surface adsorption complexes between the metal and the components of the solution. 2 figs.

51805 (INIS-SU—11, pp 255-257) **Role of intermediates in electrode reactions of metals.** Lepesov, K.K.; Kurdyumova, T.A.; Taibergenova, S.; Kozina, S.A. (AN Kazakhskoj SSR, Alma-Ata. Inst. Organicheskogo Kataliza i Ehlektrokhimii). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The results of kinetic analysis of multistage electrode reactions with the participation of lower-valence metal ions are given. The reaction intermediates were studied by rotating disc-ring electrode and impedance methods. Experimental results at solid indium electrode clearly point to the formation of In/sup +/ ions and their conversion by re- and disproportionation mechanisms. 8 refs.

51806 (INIS-SU—11, pp 270-272) **On the stepwise mechanism of the anodic dissolution of copper and indium.** Stepnik-Swiatek, B.; Malyszko, E.; Malyszko, J. 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Anodic dissolution of indium and its spontaneous dissolution in the presence of In(3) in bromide solutions were investigated. It is established that In(1) ions are formed as the products of two reactions: In reversible In(1)+e and In+2In(3)=3In(1). The efficiency of In(1) formation in solutions containing no In(3) ions is low and doesnot exceed 20%. From Tafel plot transfer coefficients α=a/sub nod/=0.82 and α/sub cat/=0.18 have been determined. Reaction In(2) reversible In(3)+e is the slowest step determining the general anodic reaction rate. 5 refs.

51807 **(INIS-SU—11) 37. Meeting. V. 1. Extended abstracts.** (International Society of Electrochemistry). 1986. 418p. (CONF-8608152—). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780183/JAW.

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Individual papers in scope for the data base are processed separately.

51808 (INIS-SU—14, pp 172-174) **Influence of processes of structure formation in mixed solvent and anion nature on cadmium ions discharge kinetics from water-dimethylformamide electrolyte.** Kuznetsov, V.V.; Bozhenko, L.G.; Kucherenko, S.S.; Fedorova, O.V. (Rostovskij-na-Donu Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii). 1986. NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780184/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Electrochemical reaction of cadmium ion discharge in water-dimethylformamide (DMF) solutions is studied. The influence of DMF concentration in the presence of different anions (ClO/sup 4/-/sup -/, F/sup -/, I/sup -/) on both reaction kinetics and mechanism is discussed on the basis of structural transformations in the mixed solvent and near the surface electrode processes.

51809 **(INIS-SU—14) 37. Meeting. V. 2. Extended abstracts.** (International Society of Electrochemistry). 1986. 422p. (CONF-8608152—). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88780184/JAW.

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Individual papers in scope were processed separately.

51810 (INIS-SU—15/A, pp 16-18) **Kinetics of boron electroextraction from ionic melts.** Ivanovskij, L.E.; Chemezov, O.V.; Nekrasov, V.N.; Batuchtin, V.P. (AN SSSR, Sverdlovsk. Inst. Ehlektrokhimii). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Kinetics of boron electroreduction from CsCl-BCl/sub 3/ and KCl-KF-KBF/sub 4/ melts has been studied by the galvanostatic method in stationary and nonstationary conditions. Analysis of polarization curves both in chloride and chloride-fluoride melts enabled to determine diffusion-limited current densities and showed irreversibility of boron ions reduction. At low cathode current densities the limiting stage of boron reduction is nor ion diffusion in the electrolyte bulk but the reaction of the charge transfer. With the increase of cathode current density the influence of the diffusion impedients in the electrolyte bulk on the process kinetics increases. 2 tabs.

51811 (INIS-SU—15/A, pp 48-50) **Structure and transport properties of ionic melts.** Smirnov, M.V.; Khokhlov, V.A. (AN SSSR, Sverdlovsk. Inst. Ehlektrokhimii). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Structure and transport properties of molten alkali metal halides and their mixtures are studied. It is shown that the transport properties in these melts can be explained in suggestion of complexing of ions not only in mixtures but also in individual salts. The bond energy of the ions in the complexes (ΔU/sub MX(sub N(n1))/) can be characteristic of their transition from one complex group to another. Contribution of the ion exchange between the complexes to transport phenomena depends on temperature and the ionic composition of melts. It grows considerably in going from lithium to cesium halides and from alkali metal chlorides to their iodides. 2 figs.

51812 (INIS-SU—15/A, pp 128-130) **Fast proton transport in solid heteropoly acids and their salts.** Leonova, L.S.; Korosteleva, A.I.; Ukshe, E.A. (AN SSSR, Moscow. Inst. Novykh Khimicheskikh Problem). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Conductivity of solid heteropoly compounds (HPC) of general formula A/sub 3/PM/sub 12/O/sub 40/xnH/sub 2/O (where A=H, Li, Na, K, Rb, Cs, MH/sub 4/; M=Mo, W) have been measured in the temperature range 213-300 K. It is shown that conductivity depends essentially on the A/sup +/-cation nature, and there is no dependence between the quantity of acid protons in the HPC-molecule and the protonic conductivity. The correspondence of the NMR-spectra and conductivity data allow to conclude that only the protons are the mobile charge carriers in all HPC studied. 4 refs.; 1 fig.

51813 (INIS-SU—15/A, pp 175-177) **Raman spectra of ZrO/sub 2/ and CeO/sub 2/ based oxide electrolytes.** Strekalovskij, V.N.; Palguev, S.F.; Vovkotrub, E.G. (AN SSSR, Sverdlovsk. Inst. Ehlektrokhimii). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Raman spectroscopy study of the products of interaction in CeO/sub 2/-CaO, CeO/sub 2/-Ho/sub 2/O/sub 3/, ZrO/sub 2/-Y/sub 2/O/sub 3/, ZrO/sub 2/-CaO, ZrO/sub 2/-ScO/sub 3/ systems in the regions of formation of fluoride solid solutions is presented. 2 refs.; 1 fig.

51814 (INIS-SU—15/A, pp 452-454) **Electrochemical oxidation of ruthenium (4) at platinum rotating disk electrodes. Preparation and characterization of a tetrameric ruthenium (4.25) species.** Heerman, L.; Van Nyen, H.; D'olieslager, W. (Laboratorium voor Radiochemie, K.U.Leuven (Belgium)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8606152—).

From 17. international Rochester conference; Rochester, NY, USA (2 Jun 1986).

The results of a voltammetric study of the oxidation of Ru/sub 4/(OH)/sub 12//sup 4+/ at platinum rotating disk electrodes are reported. Evidence is presented that the oxidation product is a tetrameric ruthenium ion, with 4.2 S formal oxidation state which was prepared by controlled-potential coulometry and characterized by adsorption spectroscopy. 9 refs.; 3 figs.

51815 (INIS-SU—15/A, pp 493-495) **Peculiarities of electroreduction of the oxygen-containing anions of halogens depending on the halogen position in Periodic table.** Kvaratskhelia, R.K.; Machavariani, T.Sh.; Kvaratskhelia, G.R. (AN Gruzinskoj SSR, Tbilisi. Inst. Neorganicheskoj Khimii i Ehlektrokhimii). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The analysis of the experimental material on the electroreduction of the O-anions of halogens (x) shows a connection between the reducibility of the latters and the halogen position in Periodic system. The ability for reduction of XO/sub 3//sup -/ and XO/sub 4//sup -/ anions increases in the following sequence: ClO/sub 3//sup -/ < BrO/sub 3//sup -/ < IO/sub 3//sup -/ and ClO/sub 4//sup -/ < BrO/sub 4//sup -/ ≦ IO/sub 4//sup -/. LaCl/sub 3/ additions have not to exercise noticeable accelerating influence on the processes of electroreduction of IO/sub 3//sup -/ anions. 7 refs.; 1 tab.

51816 (INIS-SU—15/A, pp 507-508) **Electrochemistry of complex combinations with organic ligands.** Mambetkaziev, E.A. (Teacher's Training Institute, Ust'-Kamenogorsk (USSR)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The electrochemical behaviour of Cd(2), Ni(2), Fe(2), Fe(3), In(3), Pb(2) complexes with organic bi-and polydentate ligands have been studied by methods of classical and alternating current polarography. Cadmium and indium complexing depending on pH value and the nature of the ligands (bipyridyl isomers, phosphoric acid esters) is discussed.

51817 (INIS-SU—15/A, pp 520-522) **Electrode kinetics of indium in the presence of hydroquinone.** Nikoloski, N.; Popov, B.; Kirkov, P.; Grcev, T.; Arsov, L.; Prusi, A. (Faculty of Tekhnology and Metallurgy, Skopje (SFRJ)). 1986. NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780185/JAW. (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

The kinetics of deposition of indium on a stationary drop of In amalgam from 0.038 M InCl/sub 3/+0.5 KCl solution in the presence of and without hydroquinone have been studied. It is shown that mechanisms of the process were the same both for the systems with hydroquinone and for the pure solution. 8 refs; 1 fig.; 1 tab.

4005 Photochemistry

REFER ALSO TO CITATION(S) 51793

51818 **Charge transfer interaction between a pair of electronically excited moieties: Very slow charge neutralization of intramolecular ion pairs formed by biphotonic excitation of diarylmethanes.** Modiano, S.H.; Locke, R.J.; Lim, E.C. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202). *Journal of Chemical Physics;* 89: No. 8, 5345-5347(15 Oct 1988).

It is shown that biphotonic excitation of diarylmethanes leads to the formation of ion pairs with extremely long time scale of charge recombination.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 52433

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 50839

51819 **(BARC—1381) Radiochemistry Division: triennial progress report (for) 1983-1985.** Datta, T. (ed.) (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 245p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88704074/JAW.

The present report includes contributions pertaining to the studies of nuclear and chemical properties of actinides. These studies have been mostly concerned with the basic investigation, besides the research and development work connected with chemical quality control of plutonium-based fuels for trace metallic constituents. The nuclear properties are being studied in the Nuclear Chemistry and Instrumentation Section while the chemical properties are being studied in the Actinide Chemistry Section and the Spectroscopy Section. The work in the Actinide Chemistry Section deals essentially with properties of ions in solutions and preparation of solid compounds, to understand the complexing behaviour of actinides. The work in the Spectroscopy Section is concerned essentially with the study of actinide solids using EPR, TSL and optical spectroscopic techniques. The considerable advances made in the basic study of actinides are reflected in the number of publications in well-known international journals. The research and development work of the Division is fully supported by Instrumentation Group of the Division which looks after the maintenance of instruments of not only the Radiochemistry Division but also the Fuel Chemistry Division and design and fabrication of special electronic instruments needed for the research and development work.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 50489, 50658, 50892, 50909, 50910, 51632, 51850, 51926, 51933

51820 **(CRIE—685005) Application of arc plasma technology. Present and future problems.** Shibuya, Masatoyo; Inaba, Tsugunori. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Jun 1986. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770155/JAW.

Study was made on the research and development, on the present status and application of arc plasma with high temperature and high energy obtained by a plasma torch. The results are as follows: 1. Arc plasma is being applied in various technology and may enwiden its application. 2. Establishment of control technology and research on attaining longer life of electrode are required. 3. Dismantling technology of nuclear facilities, reduction of volume of radio-active non-combustible nuclear waste, evaluation technology for arc-proof capability of power distribution materials, etc. are desired to be promoted. 4. Cost increase of D.C. conversion unit is expected as the utilization technology goes for larger capacity; therefore, the development of A.C. type torch should be started. (24 figs, 8 tabs, 59 refs)

42 ENGINEERING

51821 **(SAND—88-0572C) Sensitivity of energy accommodation modelling of rarefied flow over reentry vehicle geometries using DSMC [Direct Simulation Monte-Carlo].** Bartel, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 23p. (CONF-880781—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014522/JAW.

From 16. international symposium on rarefied gas dynamics; Pasadena, CA, USA (11 Jul 1988).

This paper compares the sensitivity of energy accommodation in the modelling of the gas/wall interaction for rarefied flow over a typical reentry vehicle geometry using the Direct Simulation Monte-Carlo (DSMC) algorithm. The reflected molecule's energy accommodation was varied while a uniform angular distribution was assumed. The freestream conditions were $M\infty = 27.5$ and altitudes of 76.2 and 91.4 km. The ratio of the freestream stagnation temperature to the wall temperature was approximately 100. Surface pressure, shear stress, and heat transfer distributions as well as drag coefficients are presented for varying degrees of accommodation. These will be compared to the results from classical specular and diffuse models.

51822 **(UCID—21423) Low-altitude orbits for space-based interceptors.** Duffy, P.B.; Cunningham, C.T. (Lawrence Livermore National Lab., CA (USA)). Jul 1988. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013955/JAW.

This study has two goals: The first is to quantitatively evaluate several issues concerning basing SBIs at low altitudes in response to fast-acting ICBMs. These issues are how much is performance improved with low-altitude orbits, what air-drag penalty is incurred at low altitudes, and can elliptical orbits be used to reduce air drag? The second goal is to use the same quantitative methods to find optimum orbit altitudes against various threats. Our approach to this problem is relatively narrow: we try to identify altitudes that get the best defense performance from a given amount of rocket propellant. Our study has four main conclusions. First, the performance of SBI defenses in general will not be improved much by reducing the basing altitude. Second, elliptical orbits do not save stationkeeping fuel compared to circular orbits, unless inclinations within fuel compared to circular orbits, unless inclinations within a few degrees of 63. 4{degree} can be used. Third, if SBIs have more than about 90 sec to reach their targets, altitudes above approximately 400 km are the most fuel efficient, and altitudes can be raised to 500 km or higher with very little decrease in effectiveness or increase in fuel consumption. The increased survivability presumably obtained at higher altitudes should be worth the cost. Finally, SBI defenses are probably not practical if fast threats or long defense start-up delays reduce SBI flight times below about 50 sec. In this situation, conceivable options for the defense - either very low orbits or very high speed SBIs, or a very large number of SBIs - all require unreasonably large amounts of propellant. 12 refs., 18 figs., 1 tab.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 50548, 50574, 50732, 50745, 50814, 50843, 50843, 50852, 50853, 50854, 50855, 50856, 50857, 50858, 50859, 51112, 51113, 51114, 51115, 51116, 51141, 51142, 51143, 51539, 51572, 51605, 51921, 52598, 52788, 52898, 52911

51823 **(BNL—41517) Underground Superconducting Power Transmission Systems and the outlook for this technology.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-880937—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015853/JAW.

From Conference on electrical applications of superconductivity; Orlando, FL, USA (21 Sep 1988).

Superconducting Power Transmission Systems have been developed in many industrialized countries -- in the US a short prototype (110 meters in length) operated for several years at the 1000 MVA (3 phase) level. The likely application niches and cost estimates have been studied in cooperation with electric utility companies. The lessons learned from the R and D phase are discussed. The development of the ceramic oxide class of superconductors has raised expectations that superconductors may indeed find application in electric power transmission networks. Developmental progress of this new class of materials is discussed with emphasis on the materials properties required for transmission line use. 19 refs., 1 fig., 4 tabs.

51824 **(CONF-880899—1) An intelligent integrated sensor system for the ORNL mobile robot.** Mann, R.C.; Jones, J.P.; Beckerman, M.; Glover, C.W.; Farkas, L.; Han, J.; Wacholder, E.; Einstein, J.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p. (CESAR—88/48). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015554/JAW.

From IEEE international symposium on intelligent control; Arlington, VA, USA (24 Aug 1988).

The mobile robot prototypes developed at the ORNL Center for Engineering Systems Advanced Research (CESAR) are equipped with sonar sensors and CCD cameras that are used to support autonomous navigation and simple inspection tasks in an a priori unknown and unstructured dynamic environment. A laser range camera is being added to the sensor suite of HERMIES III, a mobile robot that is currently being built. This paper summarizes work directed at extracting information from data collected with these sensors and integrating it, in order to produce reliable descriptions of the robot's environment. Specifically, the paper describes the integration of two-dimensional vision and sonar range information. All operations are carried out on-board the mobile robot using a 16-processor hypercube computer. 14 refs., 2 figs.

51825 **(CONF-880899—3) An intelligent dynamic simulation environment: An object-oriented approach.** Robinson, J.T.; Kisner, R.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016362/JAW.

From IEEE international symposium on intelligent control; Arlington, VA, USA (24 Aug 1988).

This paper presents a prototype simulation environment for nuclear power plants which illustrates the application of object-oriented programming to process simulation. Systems are modeled using this technique as a collection of objects which communicate via message passing. The environment allows users to build simulation models by selecting iconic representations of plant components from a menu and connecting them with the aid of a mouse. Models can be modified graphically at any time, even as the simulation is running, and the results observed immediately via real-time graphics. This prototype illustrates the use of object-oriented programming to create a highly interactive and automated simulation environment. 9 refs., 4 figs.

51826 **(DP-MS—88-25) Experimental measurements of air cleaning with water sprays.** Hyder, M.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1988. Contract AC09-76SR00001. 18p. (CONF-880815—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015394/JAW.

From 20. DOE/NRC nuclear air cleaning conference; Boston, MA, USA (22 Aug 1988).

The effectiveness of water sprays for removal of gaseous and particulate fission products from air was studied experimentally, to determine the value of existing and proposed spray systems at the Savannah River reactors for cleaning the reactor room air following a hypothetical severe accident. The interaction of spray droplets with iodine and with cesium aerosols formed by combustion were measured separately. In the case of iodine, the results were compared to the theoretical treatment of Albert, spray pH predicted by the theoretical model was confirmed. The aerosol studies demonstrated the effectiveness of sprays in removing aerosol particles larger than 1 micrometer.

51827 **(EMR/MTL—MTL88-16) The effect of mechanical damage on fracture initiation in linepipe. Part 2. Gouges.** Wang, K.C.; Smith, E.D. (Canada Centre of Mineral and Energy Technology, Ottawa, Ontario. Metals Technology Labs.). Mar 1988. 24p. (MICROLOG—88-02663). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

The effect of mechanical gouges on the fracture of pipelines was evaluated by tensile tests of flattened transverse specimens with artificial defects as well as by pressurization tests of gouged pipe specimens. The results of tests showed that tensile specimens with machined notches have a 15% higher notch strength (maximum nominal stress) than specimens without notches. Specimens with pressed notches have a 50% higher notch strength and specimens with gouges have notch strengths in between the two. Specimens with a gouge depth less than 22% will not fail in the gouges region. The failure stress of linepipe with a gouge can be conservatively predicted by the Battelle flow stress dependent model of part-through flaws provided the maximum gouge depth and the corrected gouge length are used. 9 refs., 11 figs., 5 tabs.

51828 **(EUR—8928) Measurements and interpretation of dynamic loads on bridges (2nd phase): Final report, 1 July 1980--31 December 1982.** Sanpaolesi, L.; Caramelli, S.; Del Corso, R.; Favilli, A. (Commission of the European Communities, Luxembourg; Pisa Univ. (Italy). Ist. di Scienza delle Costruzioni). 1984. 280p. (In Italian). NTIS (US Sales Only), PC A13. Order Number DE88012625/JAW.

In the framework of collaboration with other European Scientific Institutes participating in the common research program of this second phase, the Italian Group worked on the following themes: a) A new series of traffic and stress measurments has been executed on the Calambrone bridge. A further series of measurements has been done on the Rio Verde bridge in order to extend and improve the experimental data. For both bridges the definition of C.A.L. (characteristic Axial Load) was determined; b) The dynamic effect induced by moving loads, with theoretical and experimental analysis was studied. In particular, the influence of the parameter "Vehicle Speed" on the dynamic effect and consequently on the fatigue behavior was analysed; c) A method of analysis of stresses over orthotropic plate frameworks was also studied, in order to find the best model by using the method of finite elements. The results obtained by the numerical method have been compared with the experimental data of research work on English, French and Italian bridges.

51829 **(FOA-B—40287-B4) Methods to monitor biodeterioration of jet fuel during long-term storage in rock caverns.** Roffey, R.; Norqvist, A.; Edlund, A. (National Defence Research Institute (FOA 4), Umeaa (Sweden). Div. of Microbiology). (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Aug 1986. 17p. (CONF-8607123—1). NTIS (US Sales Only), PC A03; 4. Order Number DE88754398/JAW.

From 2. international conference on long-term storage stabilities of liquid fuels; San Antonio, TX, USA (29 Jul 1986).

During long-term storage of jet fuel on a fluctuating waterbed in rock caverns, the fuel can become corrosive due to the activity of sulfate-reducing bacteria which produce hydrogen sulfide. In order to study the problems with biodegradation and increased corrosivity of jet fuel during storage, it was necessary to develop more sensitive methods to monitor these processes. It was found that the standard silver strip test (IP 227/73) was not sensitive enough to, at a very early stage, indicate if there was risk for a fuel becoming corrosive. This led to the development of a more sensitive and quantitative method to measure corrosivity based on piezoelectric crystals. Elemental sulfur in the range of 1-5 mg/l was found to be important for the corrosive effect, why a polarographic method was developed with a sensitivity down to 0.1 mg/l. Different methods to monitor the microbial processes in the waterbed will be discussed. The use of these developed methods to monitor the situation in a rock cavern is presented. (authors).

51830 **(GEPP-TIS—1064) Surface flashover of insulators.** Miller, H.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 31 Aug 1988. Contract AC04-76DP00656. 46p. NTIS, PC A04/MF A01. Order Number DE88017290/JAW.

This paper reviews surface flashover (i.e., voltage breakdown along the surfaces of insulators), primarily in vacuum, although some comments are made about surface/flashover in high pressure gases. Theories and models relating to surface flashover are discussed, along with pertinent experimental results. Also, some suggestions are made regarding how to choose the material, geometry, and processing when selecting an insulator for a particular application.

51831 **(GEPP-TIS—1076) A review of anode phenomena in vacuum arces.** Miller, H.C. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). Sep 1988. Contract AC04-76DP00656. 44p. NTIS, PC A03/MF A01. Order Number DE88017304/JAW.

This report discusses arc modes at the anode, experimental results pertinent to anode phenomena, and theoretical explanations of anode phenomena. The dominant mechanism controlling the formation of an anode spot appears to depend upon the electrode geometry, the electrode material, and the current waveforms of the particular vacuum arc being considered. In specific experimental conditions, either magnetic constriction in the gap plasma or gross anode melting or local anode evaporation can trigger the transition. However, the most probable explanation of anode spot formation is a combination theory, which considers magnetic constriction in the plasma together with the fluxes of material from the anode and cathode as well as the thermal, electrical, and geometric effects of the anode in analyzing the behavior of the anode and the nearby plasma. 88 refs., 6 figs., 8 tabs.

51832 **(INIS-mf—11294) Using ordinary crystals for radiation shielding.** Tugrul, B.; Yavuz, M.A.; Okka, M. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1986. 5p. (In Turkish). (CONF-8610433—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703912/JAW.

From Industrial cooperation in the field of nuclear technology; Istanbul, Turkey (15 Oct 1986).

Small volumes with lead brick and lead glass shielding are used, and in nuclear technology we call them "hot cell". Furthermore for separating the exposure rooms from the operator rooms lead glassed windows of heavy concreate walls can be used. Unfortunately, these glasses can not be produced in Turkey. ordinary crystals which have lead-oxide in them, can be produced in Turkey, in this essay we have investigated the usage of ordinary crystals for the radiation shielding. Crystals have been tested with different types of radiation and "radiation absorbtion" curves, "half thickness" and "tenth value thickness" have been calculated.

51833 (KURRI-TR—294, pp 77-81) **Improved solid angle method for nuclear criticality calculation of multi-unit system.** Okuno, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Oct 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

51834 (KURRI-TR—294, pp 1-9) **Analysis of criticality safety experiments with WIMS-family code system and their comparison with other calculations.** Kadotani, Hiroyuki. (Century Research Center Corp., Tokyo (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

The WIMS Library consists of 69 groups ranging from 10 MeV to 0 eV. The fast energy region contains 14 groups from 10 MeV to 9.118 keV and the resonant energy region consists of 13 groups from 9.118 keV to 4 eV. Processing for resonance cross section is performed in the latter region. The thermal energy region, where upward scattering processes are treated, is composed of 42 groups from 4 eV to 0 eV. An equation is derived which gives the effective resonance integral of a homogeneous system in the from of a function of the potential scattering cross section. Some corrections are made to obtain accurate values. Such corrections are required to applying a calculation for an isolated fuel rod to an assembly, to evaluate the effect of overlap of resonance, and correct an error due to the NR approximation. The WIMS Library is based on the UKAEA Nuclear Library. The GENEX code is used to determine the resonance cross section according to the multi-level, multi-channel theory and the SDR code is employed to calculate the effective resonance integral. Bench mark tests are made and results are analyzed. The tests covered fuel rods for fast tests reactor immersed in light water, solution fuels, and mixture of solid and solution fuels. Calculations are found to agree well with measurements. (Nogami, K.).

51835 (KURRI-TR—294, pp 25-32) **Effect of nonuniform fuel distribution.** Katakura, Jun-ichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

In order to ensure the subcriticality of nuclear fuel, the method of controlling the mass, form or dimensions below the limit values and the method of confirming subcriticality by calculation are taken, but at this time, it is often assumed that the concentration of fuel is constant in a fuel region, or fuel rods are arranged at constant intervals. However, in the extraction process in fuel reprocessing or in fuel storage vessels, the concentration distribution may arise in fuel regions even though temporarily. Even if subcriticality is expected in a uniform system, when concentration distribution arises, and an uneven system results in, criticality may occur. Therefore, it is important to grasp the effect of uneven fuel distribution for ensuring the safety against criticality. In this paper, the effect of uneven fuel distribution is discussed, centering around the critical mass. The examples in literatures and the examples of calculation of uneven fuel distribution are shown. As the result of calculation in Japan Atomic Energy Research Institute, in a high enrichment U-235-water system, the critical mass decreased by about 7 % due to uneven distribution, which nearly agreed with the result of Clark of about 6 %. As for a low enrichment system, the conspicuous decrease of the critical mass was not observed. (Kako, I.).

51836 (KURRI-TR—294, pp 33-40) **Preliminary analysis on nonuniformly-loaded cores of the Kyoto University Critical Assembly, KUCA.** Yamane, Yoshihiro; Hirano, Yasushi; Nishina, Kojiro. (Nagoya Univ. (Japan). Faculty of Engineering). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

Special safety measures are required in reprocessing facilities, where various physical and chemical forms of fissionable materials are involved in various processes. In particular, special care should be given to the systems handling solutions. In these solution-handling systems, inhomogeneous conditions are very likely to occur due to concentration gredients cause by gravity and local accumulation of solvents and fuel substances. A plan has been worked out for study on the inhomogeneity in these systems by using the Kyoto University Critical Assembly (KUCA). The present report describes a preliminary analysis of nonuniformly-loaded cores by Monte Carlo Calculation. Calculations are made to determine: (1) effect of the ratio II-U-235 on the infinite multiplication factor of a homogeneous model consisting of basic elements (fuel plate + polyethylene plate) as unit cells and (2) effective multiplication factor of a model consisting of inhomogeneous fuel units and polyethyle reflectors. Results show that some inhomogeneous models can give a larger effective multiplication factor than that for the homogeneous model. (Nogami, K.).

51837 (KURRI-TR—294, pp 41-49) **Outline of the preliminary edition of nuclear criticality safety handbook of Japan.** Naito, Yoshitaka. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

There are a number of features in the method of criticality safety analysis and evaluation adopted in the original draft of this Handbook. The representative matters of them are shown. The original draft of this Handbook is bascially composed of three parts, that is, the part on the fundamental way of thinking on criticality safety management, the part on criticality safety analysis and evaluation, and the part on the requirement, management system and the matters to which attention should be paid for equipment, system, facility and machinery, which are demanded for maintaining criticality safety. As to the base of the criticality safety evaluation method described in this original draft, the 'Report of the results of criticality safety analysis data and program preparation works' shall be referred to, and as for the detailed data used for the safety analysis and evaluation, the 'Collection of data for Criticality Safety Handbook' attached to this original draft shall be referred to. This is the summary of the accomplishment of the Criticality Handbook Expert Committee for four years, but it is desirable to revise this hereafter as the research and engineering advance. The method and numerical values described in this original draft are sufficiently safe. (Kako, I.).

51838 (KURRI-TR—294, pp 82-87) **Critical experiment of a coupled core in the KUCA.** Misawa, Tsuyoshi; Shiroya, Seiji; Kanda, Keiji. (Kyoto Univ. (Japan). Faculty of Engineering). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

It is important to accurately determine the degree of subcriticality in the system in which nuclear fuel units are dispersed so as to maintain subcritical condition. The degree of subcriticality is determined mostly by calculation. The experiment on criticality safety is frequently carried out on a critical system composed of plural subcritical units. In the Kyoto University critical assembly (KUCA), the measurement of the degree of subcriticality by pulsed neutron method has been carried out so far, but in fiscal year 1987, for the purpose of obtaining the experimental data at the time of criticality in a system composed of plural units, the experiment on a light water moderation, light water reflection core of division into two type was carried out at the C stand. This time, in the core of division into two type of C45 (5 rows) using a 4.54 mm pitch fuel frame, the change of criticality amount and neutron flux distribution were measured when the light water gap at the middle of the core was changed. The experiment and its results, the analysis using the SRAC system and the JACS code system and the results of calculation are reported. The research on the statical characteristics of the light water core of division into two type is expected to be carried out under other conditions. (Kako, I.).

51839 (KURRI-TR—294, pp 88-91) **Joint United States-Japanese criticality data development program, (1). Summary of experiments and analysis.** Matsumoto, Tadakuni; Funabashi, Hideyuki; Kishimoto, Yoichiro; Haire, M.J.; Smolen, G.R.; Whitesides, G.E. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

The United States-Japan cooperation between the Department of Energy and the Power Reactor and Nuclear Fuel Development Corp. in nuclear fuel cycle field became full scale by the revision of the United States-Japan Fast Reactor Agreement in January, 1979. First, the waste management working group was added, further the FBR fuel reprocessing working group was organized in May, 1982, and as the concrete items of cooperation, the development of remote techniques and joint criticality experiment were taken up. The joint criticality experiment was started in August, 1983, to carry out the research on criticality regarding the development of FBR fuel cycle. The PNC advances the design, research and development of FBR fuel recycle testing facilities for processing FBR spent fuel, aiming at the start of operation around 2,000. As of August, 1986, the experiment on the limit concentration of Pu + U solution and the experiment of fuel pins standing in organic solvent were finished. The experiment on the basic case of Pu + U solution and that on fixed neutron absorbers are in progress. The outline of the joint research and the criticality experiment, and the analysis of the experimental results are reported. (Kako, I.).

51840 (KURRI-TR—294, pp 95-102) **Criticality safety research by using NUCEF critically facility.** Kobayashi, Iwao; Tachimori, Shouichi; Suzaki, Takenori; Takeshita, Isao; Miyoshi, Yoshinori; Nakajima, Ken; Sakurai, Satoshi; Yanagisawa, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

In nuclear fuel facilities, criticality safety is to be ensured by limiting the composition of nuclear fuel and the size of the facilities so that criticality is never attained. This limiting condition must be properly set up so as to satisfy the safety and the economical efficiency simultaneously, because it is directly related to the scale and the capacity factor of facilities. In order to verify the propriety of its setting-up and the propriety of a criticality accident acenario, the following three items must be studied, that is, the acquisition of basic criticality data, the evaluation of source terms at the time of criticality accidents, and the criticality safety at the time of abnormal process. In order to carry out these studies synthetically, also the development of the related techniques such as the measurement of high subcriticality degree is necessary. In Japan Atomic Energy Research Institute, in order to carry out these studies, the research using the nuclear fuel cycle safety engineering research facilities (NUCEF) is planned, of which the completion is scheduled in fiscal year 1990. The objective, necessity and the contents of research of the above three themes are described. Also the development of the techniques of measuring high subcriticality degree and the development of a general nuclear substance management system are explained. (Kako, I.).

51841 (KURRI-TR—294, pp 92-94) **Joint criticality data development program between PNC and USDOE, (2). Development of subcriticality measurement monitor.** Seino, Hideaki; Fukumura, Nobuo; Matsumoto, Tadakuni; Mihalczo, J.T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW. (CONF-8702126—).

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

The development of the technology of criticality safety management for FBR spent fuel reprocessing facilities is carried out. As a part of this development, in order to apply the Cf-252 source-driven neutron noise analysis method proposed by J. Mihalczo of Oak Ridge National Laboratory in USA to the evaluation of the accuracy of design codes and subcriticality monitors, a subcriticality measuring system (SMS) was developed. The important points in this development were the solution of high speed signal processing when the SMS is applied to an actual plant in which the reactivity changes, the estimation of the limit of measuring subcriticality in a subcritical system and the investigation into the effect of spontaneous fission substances such as Pu-240 in a subcritical system. This development was carried out on the joint United States-Japanese criticality data development program of the Department of Energy of USA and the Power Reactor and Nuclear Fuel Development Corp. The principle and constitution of the SMS are described. For confirming the performance of the SMS in a subcritical system, the dynamic draining experiment, static annular tank experiment and static slab tank experiment were carried out, and the results are reported. (Kako, I.).

51842 **(LBL—25732) The cryogenic systems for the AS-TROMAG test coil.** Green M.A.; Levin, S.M.; Smoot, G.F.; Witebsky, C. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 5p. (CONF-880736—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016633/JAW.

From 12. international cryogenic engineering conference and exhibition; Southhampton, UK (12 Jul 1988).

This paper describes an all helium, low heat leak cryogenic system for the testing of a superconducting magnet coil for the AS-TROMAG particle astrophysics experiment. The superconducting coil, which is projected to have a stored magnetic energy of 4 to 7 MJ, will be cooled by pumped helium from a liquid helium storage tank using a fountain effect helium II pump. The pumping system can be used to cool the cryogenic system down as well as keep the coil cold during its superconducting operation. The integration of retractable 900 A gas-cooled electrical leads with the intermediate shields and intercepts is discussed. 7 refs., 3 figs., 1 tab.

51843 **(MLM—3502(OP)) The effect of blend homogeneity on the titanium-boron reaction.** Love, C.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1988. Contract AC04-76DP00053. 6p. (CONF-880473—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012868/JAW.

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

During development of a heat source component, which uses a pressed power blend of titanium and boron as its energetic material, inhomogeneities in the Ti/B were suspected. To investigate this concern, some Ti/B was ground to achieve homogeneity, then examined and compared with unground blends. Differential thermal analysis (DTA) curves to 1600{degree}C were similar for mixtures gently blended from one to six hours; however, the DTA curve for the ground sample was different. The DTA measurements, which were conducted in vacuum and in high-purity argone, contributed to an understanding of the reaction kinetics and role played by a reaction-inhibiting oxide layer on the boron. Scanning electron microscopy (SEM) revealed the nature of the inhomogeneities. SEM and energy dispersive x-ray analyses showed the extent and types of agglomerates, which included clusters of titanium and boron together. Additional Ti/B blends were ball-milled as a function of time. SEM photos showed good homogeneity was achieved in as little as ten minutes milling time. Bomb calorimetry measurements revealed that increasing the homogeneity of the Ti/B blends by grinding or ball-milling will increase their calorific output; however, if the blend is initially well-mixed, ball milling does not increase the calorific output. 3 refs., 6 figs., 1 tab.

51844 (MMIJ—8801, pp 321-322) **Effect of blasting angle in rock cutting with water jet.** Okumura, Kiyohiko; Matsuki, Koji. (Tohoku Univ., Faculty of Engineering, Sendai, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

In this report, the results of the cutting tests with various blasting angles of a jet against the surface of the rock to be cut in the air and in the water are stated. As for the cutting test macine which was used for the tests, the depth in the water of a nozzle was 30-50cm for the underwater cutting and tests in the air were conducted by removing the side wall panels from a water tank. A jet blasting angle can be controlled by adjusting the nozzle setting angle. For the test conditions, the nozzle feeding speed, the discharge pressure and the blasting angle were combined in various ways both in the air and in the water and Shirakawa tuff was used as sample. The process of forming a cut trench by jet blasting is considerd that from around the sample surface to a certain depth, the sample is fractured by an impact force of a high pressure jet followed by the additional polishing action with rock particles separated from the sample, then the deep section is cut by the multiple effects of cavitation in the water flow, etc.. In this experiment, it was found the best to tilt the blasting angle by about 10 degrees towards the direction of nozzle feeding in order to obtain the cutting depth larger. (7 figs, 5 photos, 4 refs)

51845 (MMIJ—8801, pp 323-324) **Fluctuation characteristics of acting pressure of water jet.** Kiyono, Fumio; Saito, Takayuki; Handa, Keiji. (National Research Inst. for Pollution and Resources, Tsukuba, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

Concerning the rock cutting mechanism by a water jet, if the nature of the pressure acting onto the rock surface due to the water jet can be understood, it is considered that the problem of the above mechanism is attributed to the problem of the rock destruction under certain stress condition. From the above viewpoint, this research tries to grasp quantitatively the acting pressure of a water jet, particularly the characteristics of its fluctuation components using the self-correlation function, the cross correlation function between the discharge pressure and the acting pressure and the frequency response function, etc.. For the experiment, a three-throw plunger pump was used. Its maximum discharge pressure was 500kgf/cm^2 and its maximum discharge flow was 181/min. By controlling the revolution of a pump driving motor using an inverter, the pressure and the flow were changed. In addition, 4 kinds of nozzles from 1.1mm to 2.5mm were used. (6 figs, 2 refs)

51846 **(NAGRA-NTB—86-02) Exploratory borehole Riniken. Geology. Text volume.** Matter, A.; Peters, Tj.; Isenschmid, Ch.; Blaesi, H.R.; Ziegler, H.J. (Bern Univ. (Switzerland); Geologisches Buero Dres. Peter Kellerhals und Charles Haefeli, Bern (Switzerland)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1987. 209p. (In German). Nagra, CH-5401 Baden, Switzerland.

The Riniken well was the third borehole of the NAGRA deep drilling programme, drilled after the wells of Boettstein and Weiach. Located in the borough of Riniken (Canton Aargau) at an altitude of 385.07 m above sea level it lies approximately 3 km NNW of Brugg railway station. The well reached a total depth of 1800 m. Drilling at Riniken started on June 23, 1983 and continued until January 12, 1984. The comprehensive drillsite and laboratory studies included stratigraphic, sedimentological, mineralogical, petrographic and structural analyses in addition to a variety of petrophysical and geochemical investigations. This report presents all the data collected up until the end of September 1985. The Riniken well penetrated the ca. 800 m thick Mesozoic Tafeljura sedimentary cover, and then drilled through ca. 1000 m of the clastic fill of the N Swiss Permo-Carboniferous trough. The succession encountered extended from the Effinger Beds (Malm) down to the Upper Rotliegendes. The crystalline basement was not penetrated, but interpretation of the seismic data indicates its presence at depths between 3 and 7 km. The cored sediments display occasional fissures. Most of these fissures are filled with clay minerals, calcite and quartz. Open fissures were encountered only in the Buntsandstein and in the Rotliegendes, at a depth of around 1005 m. Water-saturated zones were recorded in the Schilfsandstein (Keuper), in the Trigonodus-Dolomit, in the Buntsandstein, and in the Rotliegendes between 950 and 1010 m. Water circulation is controlled partly by the presence of high porosity lithologies (e.g. Trigonodus-Dolomit, Buntsandstein) and partly by the occurrence of open fissures (e.g. in the Rotliegendes). However, most of the sedimentary sequence shows low permeabilities (K < 10/sup -10/ m/s). 162 refs., 2 figs., 6 tabs.

51847 **(NAGRA-NTB—86-02) Exploratory borehole Riniken. Geology. Supplement volume.** Matter, A.; Peters, Tj.; Isenschmid, Ch.; Blaesi, H.R.; Ziegler, H.J. (Bern Univ. (Switzerland); Geologisches Buero Dres. Peter Kellerhals und Charles Haefeli, Bern (Switzerland)). (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Jun 1987. 38p. (In German). Nagra, CH-5401 Baden, Switzerland.

The Riniken well was the third borehole of the NAGRA deep drilling programme, drilled after the wells of Boettstein and Weiach. Located in the borough of Riniken (Canton Aargau) at an altitude of 385.07 m above sea level it lies approximately 3 km NNW of Brugg railway station. The well reached a total depth of 1800 m. Drilling at Riniken started on June 23, 1983 and continued

until January 12, 1984. The comprehensive drillsite and laboratory studies included stratigraphic, sedimentological, mineralogical, petrographic and structural analyses in addition to a variety of petrophysical and geochemical investigations. This report presents all the data collected up until the end of September 1985. The Riniken well penetrated the ca. 800 m thick Mesozoic Tafeljura sedimentary cover, and then drilled through ca. 1000 m of the clastic fill of the N Swiss Permo-Carboniferous trough. The succession encountered extended from the Effinger Beds (Malm) down to the Upper Rotliegendes. The crystalline basement was not penetrated, but interpretation of the seismic data indicates its presence at depths between 3 and 7 km. The cored sediments display occasional fissures. Most of these fissures are filled with clay minerals, calcite and quartz. Open fissures were encountered only in the Buntsandstein and in the Rotliegendes, at a depth of around 1005 m. Water-saturated zones were recorded in the Schilfsandstein (Keuper), in the Trigonodus-Dolomit, in the Buntsandstein, and in the Rotliegendes between 950 and 1010 m. Water circulation is controlled partly by the presence of high porosity lithologies (e.g. Trigonodus-Dolomit, Buntsandstein) and partly by the occurrence of open fissures (e.g. in the Rotliegendes). However, most of the sedimentary sequence shows low permeabilities (K < 10/sup -10/ m/s). 34 figs.

51848 **(NAGRA-NTB—87-23) Program for the Stripa Project Phase 3 1986-1991.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). May 1987. 75p. Nagra, CH-5401 Baden, Switzerland.

The history of the planning and implementation of Phase 3 of the OECD/NEA Stripa Project encompasses a time period of over two years. At a meeting of the Technical Subgroups in Sweden in September 1984, it was decided that a more comprehensive plan with well defined goals should be developed prior to initiating any further investigations of fluid flow in fractured rock masses at the Stripa Mine. During the months following that meeting, a small group of technical specialists met for the purpose of developing a preliminary notion of how to integrate site characterization, groundwater flow and transport, and geochemistry technology in future investigations at the Stripa Mine. Consideration would be given to a sizable volume of rock mass in the Stripa Mine for the purpose of such investigations. Additionally, the Principal Investigator for the borehole and shaft sealing tests was asked to suggest an initial framework of an integrated project that covered the research areas of interest to engineered barriers and rock mechanics. In March 1985, the Technical Subgroups convened a meeting in Switzerland. During that meeting, a preliminary program for a tentative Phase 3 of the Stripa Project was discussed. The intended duration of a Phase 3 was established as five years, beginning in 1986. Emphasis would be placed on investigations that would represent an integration of the technical knowledge developed in Phases 1 and 2 of the Stripa Project. Specific goals were established, and proposals for tentative investigations were reviewed. In June 1985, the following general objectives of a third phase were agreed upon: To integrate various site characterization techniques and methods of analysis for the prediction and validation of ground-water flow and nuclide transport in an unexplored volume of Stripa granite. To demonstrate and verify the use of different materials and techniques for sealing ground-water flow paths in the Stripa granite. 3 figs., 21 tabs.

51849 **(NP—8770352) Optimization of hydrodynamical and elasto-hydrodynamical axial face seals by the finite element method.** Dedeken, J.R.C. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 17 Jul 1986. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770352/JAW.

Axial face seals are commonly used in rotating shafts. The dissertation investigates the parameters influencing the sealing characteristics of hydrodynamic axial face seals. A new, patent seal for high-pressure applications is presented. The differential equations describing the problem are described by a finite element method. (HAG).

51850 **(PB—88-213723/XAB) Fighting fire with foam: basics of effective systems. Technical report.** Meldrum, D.N. (National Foam System, Inc., Lionville, PA (USA)). May 1977. 18p. NTIS, PC A03.

Although foam as an extinguishing medium for fires from flammable and combustible liquids has been available for over 50 years, the past decade has seen rapid advancement in foam technology. Advances include increased knowledge of foam chemistry and rheology, engineered foam application devices, and better fire-fighting foam system design. Discussed are foam characteristics, system components, proportioning methods, types of systems (portable, fixed, semifixed) and system design. Examples of oil-rig platform, power station, and aircraft-hanger applications are described.

51851 **(PSI—5) Experimental testing of the thermal performance of finned air coolers. Final report of the project 'Air/water-heat exchangers' of the impulse programme Household Technology.** Imhof, A.; Keller, J.; Koelliker, A. (Paul Scherrer Institut, Labor fuer Energie- und Verfahrenstechnik, Wuerenlingen (Switzerland)). (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland). Lab. fuer Energie- und Verfahrenstechnik). May 1988. 115p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703939/JAW.

Finned heat exchangers are often used as regenerators in heat recovery systems or as a heat source for heat pump installations. These exchangers are usually operating as air coolers. Heat is extracted from the air flowing through the heat exchanger. If the fin temperature lies below the dew point at the air inlet, water vapour may be condensed, increasing the thermal performance of the cooler. If the air/water heat exchanger is installed outdoors, the blower is usually mounted directly at the exchaner's case. In general this leads to non-ideal air flow conditions. For the sizing of such components the manufacturers dispose of design rules which are based either on theoretical models or on experiments using a uniform air stream. These rules which are mostly internal codes of the individual companies presumably do not take into account some non-ideal conditions such as an inhomogeneous air flow, a poorly sized blower or an increased pressure drop between the fins due to condensed water vapour. Moreover, these codes are possibly not sophisticated enough to enable a correct sizing of the products for any given condition of operation, especially in heat pumps operating under condensation conditions. Therfore, the Swiss Federal Institute for Reactor Research (EIR) carried out a research program dealing with the thermal performance of commercially available finned air coolers. The results give a strong evidence that the sizing of finned air coolers involving a phase change in one of the heat transfer fluids is not yet a procedure belonging to the common knowledge of most of the manufacturers. Moreover, the correct sizing of the blower is at least as important as the sizing of the finned exchanger itself. However, it is evident that there are companies on the Swiss market which use already reliable design tools. 25 refs., 81 figs., 12 tabs.

51852 **(SAND—87-1940) Temperature profile in semi-infinite planar slab with exponential source and convective boundary condition: Application to laser heating.** Blackwell, B.F. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016746/JAW.

An analytical solution for the temperature profile in a semi-infinite planar slab with an exponentially decaying (with position) source and convective boundary condition is obtained using Laplace transforms. The appropriate dimensionless parameters are identified and the temperature as a function of these parameters is presented in graphical form. With cooling at the front surface, the maximum temperature occurs in the interior of the slab instead of at the exposed surface. The location of the temperature maximum as a function of the various system parameters is presented in graphical form. Approximate relationships are presented for small values of dimensionless time. Example calculations are presented for laser drilling with external cooling. 4 refs., 9 figs.

51853 (SAND—87-2295) MODLPAT user guide linking structural dynamic test and analysis codes. Metzler, P.K.; Martinez, D.R.; Lauffer, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 57p. NTIS, PC A04. Order Number DE88016853/JAW.

MODLPAT is an interactive program which permits the exchange of structural model and response information between the structural dynamic analysis and testing groups. The code was initially written as a translator between MODAL-PLUS and PATRAN, providing the capability to transfer geometry, connectivity, and deformed structure information. This permits the simultaneous display of animated mode shapes from test and analysis. Other utilities exist in the code to apply a coordinate system rotation, translation (i.e., shift), and scaling to the test model geometry and deformed shapes, and to normalize and concatenate deformed shape files. This link between test and analysis eliminates duplication of effort and permits the efficient transfer of structural model and response data. MODLPAT also contains a translator from MODAL-PLUS to PRO-MATLAB, providing the capability to perform interactive dynamic systems analysis calculations with the test data. Other possibilities being considered for MODLPAT are to include it as part of a general package providing the capability to transfer information among all the dynamic test and analysis codes, including: PRO-MATLAB, PATRAN, MODAL-PLUS, NASTRAN, and other system synthesis and analysis codes. This would provide one of the tools necessary for incorporating test-derived modal models directly into analysis codes using component mode synthesis techniques, as well as simplify the transfer of information required to perform test/analysis correlation studies.

51854 (SAND—88-8214) An investigation of the elastic-plastic behavior of explosively actuated valves. Emery, A.F.; Jones, B.K.; Hardwick, M.F.; Ng, R. (Sandia National Labs., Livermore, CA (USA)). Jul 1988. Contract AC04-76DR00789. 36p. NTIS, PC A03/MF A01. Order Number DE88017227/JAW.

MAVIS is a computer program for the modeling and analysis of explosive valves. Until recently, the drag forces between the plunger and the housing have been calculated by modeling the valve as a series of thin disks, then assuming an elastic interference fit between the disks of the plunger and the disks of the housing. Explosive valves constructed with new materials and new geometries, however, have made it necessary to account for plastic deformations, including strain hardening, in the MAVIS disk model. This report introduces an elastic-plastic disk model based on a combination of closed form and finite element results. The behavior of the MAVIS calculations with elastic-plastic materials is compared to various finite element representations of an explosive valve to verify the disk model and to quantify the effects of plasticity and large deformations. Finally, the elastic-plastic MAVIS calculations are compared to experimental results obtained from test valves with various materials and geometries. 5 refs., 17 figs., 1 tab.

51855 (SAND—88-8233) Development report for the H1408 storage and shipping container. Brown, M.E. (Sandia National Labs., Livermore, CA (USA)). Aug 1988. Contract AC04-76DR00789. 40p. NTIS, PC A03. Order Number DE88017228/JAW.

The H1408 (P/N 249001) shipping container is a unique design for the W84 application that provides both frequency vibration isolation and enhanced heat dissipation. The design utilizes an open framework which provides a base for the protective inner container. The inner container is protected from shock by four Aeroflex® isolators, each consisting of a horizontal coil of stainless steel wire rope. The wire rope provides a nonlinear spring action and a damping action due to internal friction in the coils. The coils supporting the inner container are located at each corner of the framework. Because of the new design, the coils provide a low-resistance heat transfer path with the framework to function as cooling fins for heat dissipation purposes. Shrapnel penetration protection is provided by a thick aluminum cap and container front area. This report summarizes the design rationale, analysis, and testing associated with the H1408 development program. The initial design was facilitates analytically using the SHELLSHOCK structural code and verified experimentally with a comprehensive laboratory testing program. The testing program, as summarized herein, demonstrated the design adequacy for all required stockpile-to-target sequence (STS) environment. 8 refs., 4 figs., 1 tab.

51856 (UCID—21336) CHAWS [Chemical Hazard Warning System] user's guide: System description and standard operating procedures, Lexington-Blue Grass Army Depot. Shinn, J.H.; Novo, M.G. (eds.). (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 141p. NTIS, PC A07. Order Number DE88014692/JAW.

The Chemical HAzard Warning System (CHAWS) has been designed to collect meteorological data and to display, in real time, hazardous chemical dispersion as a result of an accidental release. Meteorological sensors are placed strategically around each installation and are used to calculate direction and hazard distance for the release. These data are then graphically displayed on a computer screen showing a site map and arrows depicting the release direction and distance traveled. A regular workday at a Chemical Hazard Warning System (CHAWS) site consists of many activities. This chapter gives a brief overview of what is necessary to run the system on a daily basis. Other chapters of this manual present more details of the hardware and software found at the CHAWS sites so that troubleshooting and maintenance can be performed on the system. Also, manuals have been provided for the hardware manufactured by HANDAR and the computer companies. This manual is meant to serve as a supplement to those hardware manuals. Personnel operating the CHAWS system should be familiar with the MS-DOS system.

51857 (UCID—21463) Photonic streak tube differential distortion. Huen, T. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016175/JAW.

Differential distortion is defined here to suit evaluation of streak tubes for applications in Fabry--Perot velocimetry. Four streak tubes have been measured for their differential distortions. Performance comparisons are presented. This definition of spatial distortion factor is more stringment than the defined by RCS. For example, the spec'd distortion is less than 3%, according to RCA. A spot showed that spec'd was met based on RCS's definition. Clearly, the differential distortion measurement showed here convey more information as to the performance. 4 refs., 5 figs., 1 tab.

51858 (UCRL—21068) Device systems lightning project: Final report. Hasbrouck, R.T.; Johnson, J.P.; Melander, B.G. (Lawrence Livermore National Lab., CA (USA)). 10 Jun 1988. Contract W-7405-ENG-48. 393p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88016187/JAW.

This report documents a project that implemented a key recommendation of the Nuclear Explosive Lightning Vulnerability Investigation Task Force. A prototype, lightning invulnerable, nuclear explosive test device system (LIDS) was designed, fabricated, and tested. Severe threat-level simulated lightning and rocket-triggered natural lightning were discharged into both coaxial and multiconductor cables. These cables were connected to standard arming and firing (A and F) components located within the LIDS. Cables and circuits typically associated with device systems ancillary ac power were not tested. Subsequently, a detailed data analysis was carried out by the Science and Engineering Associates, Seattle, Washington, under subcontract number 9749605. This analysis confirmed the observations of the experimenters, namely that the prototype LIDS protected the safety-critical components from severe threat-level lightning transient energy. Simulated electro-explosive devices (EEDs) connected to the A and F components did not "fire" under any of the test conditions. However, current measurements for the EEDs were inconclusive, making it impossible to evaluate a safety margin for electromagnetic coupling into those circuits. Nonetheless, estimated upper bounds of peak currents and action integrals, extrapolated to severe threat levels, are significantly below the values required to fire the most sensitive EED (i.e., SE-1 detonator: required action integral = 0.1 A^2-sec; "no-fire" current = 74 A). Although the testing was intended to demonstrate

protection against a severe lightning strike, the analysis pointed out that a relatively low-level, long-duration strike could conceivably produce partial charging of A and F components. Evaluation of this phenomenon as a potential threat was beyond the scope of this report, but it should be looked into.

51859 **(UCRL—53866) Decentralized adaptive control of large scale systems, with application to robotics.** Gravel, D.T. Jr. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88015409/JAW.

Present day economic, technological, and environmental systems are large and complex. Gaining an understanding of large scale systems, that is, modeling their behavior and designing appropriate stabilizing controls, is a foremost challenge of modern system theory. One approach to large scale system modeling and control is decomposition of the large system into smaller, more manageable units. This is known as the decentralized approach. Decentralized control schemes have proven to be robust to a large range of uncertainties and nonlinearities in interconnections and subsystem dynamics. For the purpose of decentralized control, decompositions of large scale systems are typically formulated to isolate uncertainty about system behavior to the interaction between subsystems. Thereby the subsystems themselves are well modeled and decentralized controllers can be designed according to standard techniques. In this thesis, the theory of decentralized adaptive control for decentrally stabilizable systems has been developed. The new schemes depend upon local high gain feedback to stabilize local systems sufficiently to overcome interconnection disturbances, leading to a stable overall system.

51860 **(UCRL—53867) An alignment monitoring system for pinhole imaging experiments.** Schumacher, F.A.; Adams, C.H. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016097/JAW.

We have developed a simple instrument to accurately measure misalignments between a pinhole imaging assembly and the radiation source it is designed to image. Intended for remotely controlled use in the diagnostic canisters employed in underground nuclear testing, the instrument consists basically of two components: a telescope with attached TV camera, rigidly mounted to the radiation source (the nuclear device being tested), and a target rigidly mounted to the pinhole assembly. When the source and pinhole assembly are final-aligned before the canister is lowered into the test hole, the telescope and target are similarly aligned so that the telescope's crosshairs are centered on the image of a pair of illuminated x-y scales on the target. Whatever misalignment occurs between the source and the pinhole assembly as a result of lowering the canister into the hole and filling the hole with stemming material will thus be reflected in a similar misalignment between telescope and target. This enables us to determine the relative translation and relative tilt the pinhole assembly has undergone with respect to the source. The absolute tilt of the pinhole assembly is determined from a supplementary measurement made with a pair of gravity-sensing electrolytic transducers mounted on the rear (upper side) of the target.

51861 **(UCRL—97806) Gallium arsenide integrated optical devices in adverse environments.** McWright, G.; Lowry, M.; Behymer, E.; Brazes, W.; Lancaster, G.; Roeske, F. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 6p. (CONF-871161—2). NTIS, PC A02. Order Number DE88014485/JAW.

From International symposium on the technologies for optoelectronics; Cannes, France (16 Nov 1987).

We discuss preliminary measurements of the response of gallium arsenide integrated optical-waveguides to radiation from a Febetron. The Febetron produces electrons in the 300-700 keV range in approximately 3-ns FWHM pulses, with a maximum dose rate of approximately 10^{14} rad/sec. "Prompt" radiation effects were monitored on a streak camera recording system. 7 refs., 6 figs.

51862 **(UCRL—99363) LLNL SCOTS [Secondarily Contained Tritium System]: A preview.** Merrill, J.T. (Lawrence Livermore National Lab., CA (USA)). 11 May 1988. Contract W-7405-ENG-48. 16p. (CONF-8805179—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015438/JAW.

From DAMSUL committee meeting; Las Vegas, NV, USA (11 May 1988).

The Lawrence Livermore National Laboratory (LLNL) is in the process of upgrading its Tritium Facility with two new systems. The Secondarily Contained Tritium System (SCOTS) is an integrated system of enclosures designed to provide secondary containment for the facility's high risk, high pressure tritium work. The Vacuum Effluent Recovery System (VERS) allows the facility to clean up the incidental small releases in the vacuum pump exhausts and to clean up an accidental release within SCOTS. VERS was reported on at the last DAMSUL meeting in 1987 and is now nearing completion. SCOTS is in the final design stage and construction has begun. The scheduled completion date is December, 1989.

51863 **Superconducting rf cavity in a dc magnetic field.** Benaroya, R.; Shepard, K.W. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Review of Scientific Instruments;* **59**: No. 9, 2100-2101(Sep 1988).

A superconducting (SC) rf cavity has been operated in the presence of an external magnetic field up to 2.4 kG. Measurements on the 48.5-MHz cavity were performed at 4.2 K. The external field was produced by an unshielded 60-kG superconducting solenoid 5.8 cm from the cavity. No degradation of cavity Q was observed for fields on the outer surface of the cavity up to 1240 G. This result is consistent with no flux penetration of the cavity surface for fields up to the first critical field of niobium at 4.2 K, and shows that strong focusing elements with large fringing magnetic fields may be placed immediately next to Nb SC accelerating structures without causing performance degradation.

51864 **Californium-252 source-drive neutron noise measurements of subcriticality for an annular tank of aqueous Pu-U nitrate.** Mihalczo, J.T.; Blakeman, E.D.; Ragan, G.E.; Kryter, R.C.; Seino, H.; Robinson, R.C. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 387-388(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Measurements of the subcritical neutron multiplication factor, k/sub eff/, using the ^{252}Cf source-driven neutron noise analysis method were performed for an unreflected annular tank containing plutonium-uranium nitrate solution but having the central region of the annulus void of significant materials. This experiment is part of a program of collaboration between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan to study criticality safety related to the development of fast breeder technology.

51865 **Law of substitution for mixed arrays.** Koudelka, A.J. *Transactions of the American Nuclear Society;* **55**: 389-390(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The nuclear safety justification of a mixed array of dissimilar fissile units of metal units and dilute solution units, according to Clayton, has been a persistent and nagging problem. Dissimilar uranium metal or dissimilar uranium solution units in a mixed array can also create a modeling nightmare for the nuclear criticality safety engineer. Now, a calculational method known as the Law of Substitution has been developed to ensure that the k/sub eff/ of an array of uranium metal and uranium solution units will satisfy any k/sub eff/ limit set by the nuclear safety engineer. The nuclear criticality safety engineer can utilize the Law of Substitution to safely mix or substitute different uranium metal units, different uranium solution units, and more importantly, uranium metal and dilute UO_2 solution units in an array. The Law of Substitution is as follows: (1) calculate the k/sub eff/ of each unit type in its own infinite planar array. (2) Determine the edge-to-edge spacing of the infinite planar array of each type of unit to satisfy a desired k/sub eff/. (3) Select the largest edge-to-edge spacing from among the

similar units in their infinite planar arrays and use that spacing for the finite or infinite planar array of mixed units.

51866 **Code CRITEX to simulate transient criticality in fissile solutions.** Bickley, A.; Mather, D.J.; Shaw, P.M. *Transactions of the American Nuclear Society;* **55**: 406-407(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Fissile solutions are used extensively in the nuclear processing industry, and this use may expand in the future. While safety measures ensure that accidents do not occur, it has been thought prudent to develop understanding of the physical mechanisms occurring in transient criticality in fissil solutions. Experiments have provided data that are still being extended as well as some understanding of the mechanisms operating in the transients. However, in addition, it is necessary to develop calculational tools that will, in simulating the experiments, provide confidence that every aspect can be modeled adequately. For this reason, a computer code CRITEX is being developed by the UK Atomic Energy Authority.

51867 **Nuclear excursions in aqueous solutions of fissile materials.** Hetrick, D.L.; Smith, A.B. (Univ. of Arizona, Tucson (USA)). *Transactions of the American Nuclear Society;* **55**: 407-408(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Researchers have recently calculated nuclear excursions in homogeneous solution reactors and in hypothetical criticality accidents with fissile solutions in chemical processing plants. Two new features have been incorporated: the use of a complete equation of state for liquid containing gas bubbles and an improved computation of the reactivity feedback. The new approach represents the first computations of fissile solution excursions from basic principles with a complete equation of state. An important conclusion is that gas bubbles tend to appear just before peak power (less than one period), but that the gas production is very important in limiting the power. Another important conclusion is that the compressibility of the solution increases dramatically when gas appears. This has the effect of greatly limiting the pressure pulses.

51868 **Predicting accident characteristics by calculation.** Lutz, H.F. (Lawrence Livermore National Lab., CA (USA)). *Transactions of the American Nuclear Society;* **55**: 408-409(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A set of convenient articulated calculations can enable the criticality safety specialist to predict the characteristics of a possible nuclear criticality accident. These calculations are tools that can be used efficiently in routine assessments without the need for detailed codes, which are best suited for retrospective interpretations of previous excursions. With these calculations, the criticality safety specialist can obtain an estimate of credible (as opposed to worst case) consequences, an understanding of the important controls to prevent inadvertent criticality, and an evaluation of the effectiveness of prompt evacuation. A set of calculations known as the Trombay criticality formula (TCF) can be used to calculate rates of reactivity insertion. The TCF is a set of computations that enables us to predict changes in either the critical size of k/sub eff/ following alternations in the geometrical or physical parameters. Changes in size, shape, density of the core, diluent concentration of the core, density of the reflector, and thickness of the reflector can be considered. To illustrate how these tools are used, the authors consider the assessment of a metallic plutonium system and an enriched uranium solution.

51869 **Theoretical studies of transient criticality of irradiated fuel elements.** Barbry, F.; Bonhomme, C.; Hague, P.; Mather, D.J.; Shaw, P.M. *Transactions of the American Nuclear Society;* **55**: 410-411(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The use of transport flasks containing irradiated fuel is a common event, and their movements are strictly regulated by the national competent authority in order that an acceptable level of control of radiation hazards be maintained. Nonetheless it has been considered prudent to quantify the consequences of a particular hypothetical accident involving a transport package. The particular accident examined assumed that recriticality occurs during the refilling of a flask, and for the Commissariat a l'Energie Atomique (CEA) scenario, for which flasks are transported dry, the hypothetical accident occurs as the flask is slowly lowered into a storage pond. An alternative UK scenario assumes that the flask is being refilled, following breach, by a high-pressure hose. Thus, the consequences of such an accident were estimated by developing computer codes, Chateau by the CEA and Sartemp by the UK Atomic Energy Authority (UKAEA). This and other results show that the hypothetical accident in which a transport flask is brought to critical by the reentry of water gives at most a relatively mild event. In view of the considerably unlikely circumstances and conservative aspects introduced, this result shows that such an accident can be safely contained.

51870 **Model to estimate the maximum fission yield in accidental solution excursions.** Barbry, F. *Transactions of the American Nuclear Society;* **55**: 412-414(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In nuclear installations with a potential risk of criticality, safety authorities sometimes find it necessary to study a hypothetical criticality accident, based on a scenario that is as realistic as possible. The objective of this work is to estimate the phenomenology of an accident and its radiological consequences (irradiation, contamination) to make arrangements to protect personnel and the environment, and also to provide for a strategy of intervention. When considering the succinct data used as parameters that originated the accident, simple models capable of quickly providing orders of magnitude are very useful and, in our opinion, sufficient on this level of safety analysis of criticality accidents.

51871 **Analysis of transient criticality in wetted uranium dioxide systems.** Mather, D.J.; Hague, P. *Transactions of the American Nuclear Society;* **55**: 414-415(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The use of uranium dioxide powders and granules is common in the nuclear industry, and it is manufactured and stored in containers subject to stringent criticality reviews. However, inadvertent events such as the ingress of water might hypothetically cause criticality. Therefore, it is advisable that some understanding of the results of such a criticality be understood. To this end the UK Atomic Energy Authority (UKAEA) has begun to develop a computer program POWDER that incorporates some of the physical mechanism thought to act in such circumstances. Results have been obtained from the use of the POWDER code for a representative scenario in which UO_2 granules are contained in an 800-mm-diam aluminum vessel. These results provide a first analysis of transients in wetted UO_2 powders, and it is proposed to develop the POWDER code further in order that other aspects may be investigated, e.g., the effect of the reactivity feedback terms noted above.

51872 **Criticality excursions in wetted UO_2 powder.** Barbry, F.; Rozain, J.P.; Bonhomme, C. *Transactions of the American Nuclear Society;* **55**: 415-417(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Increasing amounts of fissile material in the form of uranium oxide powder are involved in the development of the electronuclear program. In spite of multiple precautions, the risk of a criticality accident exists, particularly in fuel manufacturing plants where important masses from hundreds of kilograms to several tons may be manipulated in one lot at the time of operations linked with processing, transport, and storage. The criticality safety of these installations is essentially based on moderation control, but one cannot exclude the accidental introduction water, for instance, in flasks or apparatus containing UO_2 powder. The aim of the criticality accident study performed by Commissariat a l'Energie Atomique is to acquire basic phenomenological knowledge of criticality excursions in such a medium so as to estimate the risk and the pos-

sible consequences. Taking into account the rough knowledge in this area, it does not seem realistic to intend at the present time the realization of such an accident in the laboratory without investing considerable means. The present approach involves acquiring by successive stages the data necessary for the elaboration of a calculation code that will be able to describe an accidental criticality excursion based on a credible hypothetical scenario.

4203 Lasers

REFER ALSO TO CITATION(S) 51387, 51962, 52516, 52678

51873 (AD-A—193544/4/XAB) Novel infrared band-aligned superlattice laser. Yuh, P.F.; Wang, K.L. (California Univ., Los Angeles (USA). Device Research Lab.). 2 Nov 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 51, No. 18, 1404-1406(2 Nov 1987).

A novel infrared laser is proposed which uses the intersubband optical transition in a band-aligned superlattice. In this band-aligned superlattice laser, the miniband discontinuity within the conduction or valence-band functions as a band offset in the heterojunction structure, and the population inversion is achieved by current injection as in the conventional heterojunction laser. It is more flexible than a heterojunction laser or a quantum-well laser since one may tailor the bandwidth and band structures as well as the band gap of the minibands. Also indirect band-gap materials like Si and Ge can be used for lasing in the intersubband transitions. The intersubband optical transition is similar to an atomic two-level system which exhibits low thresholds current, and a gain coefficient with weak temperature dependence and a narrow spectrum which is determined only by the line-shape function. These special features make the band-aligned superlattice laser competitive with, and perhaps superior to, the quantum well dot laser which is not presently feasible.

51874 (AD-A—193935/4/XAB) MidIR (mid-infrared) laser. Phase 1. Final report, August 1987-February 1988. Tanimoto, D.; Jeffers, W.; Shellan, J. (Laser Power Optics, San Diego, CA (USA)). 15 Apr 1988. 54p. NTIS, PC A04/MF A01.

Advances in sensor technology have led to a proliferation of electro-optical systems operating in the mid-infrared (3 to 5 micrometers). Examples are search and track sets, missile seekers, laser designators, and high-energy lasers. To counter enemy use of such systems, jamming and collecting systems which employ lasers of modest power operating within the spectral pass-band of the threat are required. A modulated, wavelength-agile, compact, mid-infrared laser of moderate average output powers is extremely attractive for infrared countermeasures and OPTINT collections applications. A unique electric-discharge gain generator design was investigated that promises significant improvements in efficiency, compactness and reliability for pulsed gas laser systems with high peak power and moderate average power outputs.

51875 (PB—88-225685/XAB) Investigation of the hydrogen source for masers. Persson, K.B.; Walls, F.L. (National Bureau of Standards, Boulder, CO (USA). Time and Frequency Div.). Apr 1988. 58p. (NBS/TN—1315). NTIS, PC A04/MF A01.

Also available from Supt. of Docs as SN003-003-02870-3.

Various engineering and phenomenological aspects of the radio-frequency discharge source for atomic hydrogen used in the masers were investigated theoretically and experimentally to provide a base for minimizing the size of the source and its power consumption. A scheme and detector were devised, permitting absolute detection of the atomic beam, and an atom-atom surface recombination theory was developed, applicable to the detector as well as to the walls of the discharge vessel. A self-starting radio-frequency circuit, allowing as little as 0.1 W power consumption by the atom source, has been developed.

51876 (SAND—88-1318) Effect of gasdynamics on resonator stability in reactor-pumped lasers. Torczynski, J.R.; Neal, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01; 1; GPO Dep., Order Number DE88016863/JAW.

A number of experiments involving reactor pumping of atomic xenon have been conducted on Sandia reactors, with lasing observed at 1.73 μm and 2.03 μm for a variety of conditions. In some of these experiments, lasing was observed to terminate well before the peak of the pumping pulse. Recent advances in gasdynamic modeling and laser resonator stability theory make it possible to discriminate between laser kinetics and gasdynamics issues to explain these terminations for some experiments. In the February/March ACRR experiment series, lasing termination and/or reinitiation that can be attributed to gasdynamically induced resonator stability transitions was observed for some conditions. A laser resonator stability theory based on the existence of a parabolic refractive index profile in the gain medium is developed in terms of an index gradient strength parameter γ^*. The theoretically determined critical values of γ^* for instability and restablization for the experimental configuration are in good agreement with gasdynamic computations of the γ^* values at the experimentally observed termination and reinitiation times. Generic computations of the variations of γ^* with the normalized pressure rise (the only important dynamic variable) are presented for most of the other ACRR experiments. In addition, laser intensity profile measurements made with pyroelectric detector arrays for experiments on the ACRR and SPR III reactors provide additional information about higher-order laser mode behavior. 9 refs., 26 figs., 1 tab.

51877 (UCRL—50021-86) 1986 Laser Program annual report. Rufer, M.L.; Murphy, P.W. (eds.). (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 799p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88014097/JAW.

The report contains update information on laser related programs. The specific topic areas covered are: general laser program overview; laser target design; Nova systems and experiments; Nova technology development; target materials development; laser research and development; high-average power lasers; and ICF applications studies.

51878 Soft-x-ray amplification at 50.3 A in nickellike ytterbium. MacGowan, B.J.; Maxon, S.; Keane, C.J.; London, R.A.; Matthews, D.L.; Whelan, D.A. (Lawrence Livermore National Laboratory, University of California, P.O. Box 5508, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 9, 1858-1863(Sep 1988).

Nickellike ions of ytterbium (Yb/sup 42+/) have been produced in long exploding foil plasmas. The plasmas were formed by short-pulse laser irradiation of thin foils of ytterbium with line-focused high-intensity 0.53-μm light. Soft-x-ray line emissions at 50.26 and 56.09 A are identified as 4d—4p, J = 0—1 transitions in the nickellike ionization stage of ytterbium. The energy emitted in the line at 50.26 A along the axis of the plasma is observed to increase nonlinearly with plasma length, consistent with a small-signal gain of 1.2 +- 0.4 cm/sup -1/.

51879 Experimental synthesis of phase-diffusing optical fields. Elliott, D.S.; Smith, S.J. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80309). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 9, 1927-1939(Sep 1988).

Techniques are described for synthesizing a statistically well-characterized radio-frequency noise spectrum and imposing this noise spectrum on a well-stabilized laser beam by means of extracavity phase and frequency modulation. The basis of the noise spectrum is the Gaussian noise-voltage spectrum derived from shot noise. The Gaussian property is carefully preserved at every step, ensuring that correlation functions to all orders can be represented in terms of the lowest-order correlation function, which, in turn, is the Fourier transform of the power spectrum, according to the

Wiener—Khintchine theorem. The power spectrum can be measured and controlled, in a range that has Lorentzian and Gaussian forms as limiting cases, by controlling the bandwidth and amplitude of the noise voltage at the source. The objective of this methodology is the definitive experimental study of nonlinear-optical absorption processes, all such processes requiring knowledge of higher-order correlation functions for complete definition.

51880 **Liquid-crystal laser optics: design, fabrication, and performance.** Jacobs, S.D.; Cerqua, K.A.; Marshall, K.L.; Schmid, A.; Guardalben, M.J.; Skerrett, K.J. (Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, New York 14623-1299). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 9, 1962-1979(Sep 1988).

We describe the development of laser optics utilizing liquid crystals. Devices discussed constitute passive optical elements for both low-power and high-power laser systems, operating in either the pulsed or cw mode. Designs and fabrication methods are given in detail for wave plates, circular polarizers, optical isolators, laser-blocking notch filters, and soft apertures. Performance data in the visible to near infrared show these devices to be useful alternatives to other technologies based on conventional glasses, crystals, or thin films. The issue of laser damage is examined on the basis of off-line threshold testing and daily use in OMEGA, the 24-beam Nd:glass laser system at the Laboratory for Laser Energetics. Results demonstrate that long-term survivability has been achieved.

51881 **Laser for providing rapid sequence of different wavelengths.** Rohde, R.S.; Ahl, J.L. (to Secretary of the Army, Washington, DC). US Patent 4,751,706. 14 Jun 1988. Filed date 31 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A stable laser for providing a rapid sequence of laser beams of different wavelengths is described including: a lasing medium; means for pumping the medium; an optical cavity having a laser beam optical path, including the series arrangement of: a partially transparent mirror, a pair of reflective diffraction gratings, a rotating aperature disc, a slotted plate, a fully reflective mirror, wherein the lasing medium is between the gratings and the partially transparent mirror; and an encoder responsive to the rotation of the disc and providing a signal to the means for pumping.

51882 **Single-element optical injection locking of diode-laser arrays.** Hadley, G.R.; Hohimer, J.P.; Owyoung, A. (to Dept. of Energy, Washington, DC). US Patent 4,751,705. 14 Jun 1988. Filed date 7 Oct 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A steerable beam semiconductor laser apparatus is described comprising: an array of semiconductor laser elements, a variable frequency optical energy source, and means for directing optical energy from the optical energy source along the axis of the array onto one end element of the array of semiconductor laser elements to lock the array into a desired spatial and spectral laser emission.

51883 **Quantum electronic properties of the Na/sub 3/Ga/sub 2/Li/sub 3/F/sub 12/:Cr/sup 3+/ laser.** Caird, J.A.; Payne, S.A.; Staver, P.R.; Ramponi, A.J.; Chase, L.L.; Krupke, W.F. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 1077-1099(Jun 1988).

Few of the existing Cr/sup 3+/ vibronic lasers have achieved the slope efficiency and tuning range expected based on their known spectroscopic properties. In order to discover the causes of this behavior, the performance of chromium doped gallium fluoride garnet, Na/sub 3/Ga/sub 2/Li/sub 3/F/sub 12/:Cr/sup 3+/, as a laser material has been investigated experimentally. The data reported here include absorption and emission spectra, emission rates, quantum efficiency, laser wavelength tuning range, laser output slope efficiencies, and excited state absorption spectra. Similar properties of the alexandrite laser material were studied for comparison. The results indicate that the performance of the gallium fluoride garnet laser is severely limited by Cr/sup 3+/ excited state absorption (ESA). A model is presented to account for the unexpected nature of the ESA, which appears to be a common problem for all Cr/sup 3+/ vibronic lasers. Criteria are suggested for choosing Cr/sup 3+/ hosts for which the effects of ESA will be minimized.

51884 **Spectroscopic and laser properties of Pm/sup 3+/.** Shinn, M.D.; Krupke, W.F.; Solarz, R.W.; Kirchoff, T.A. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 1100-1108(Jun 1988).

An investigation of some of the spectroscopic properties of the promethium ion (Pm/sup 3+/) has been made to assess its feasibility for laser action. The fluorescence spectra and decays from the /sup 5/F/sub 1,2/ manifolds were measured in 11 dielectric materials. The calculated peak emission cross sections are comparable to those for Nd/sup 3+/ in the same hosts. For one host, a lead-indium phosphate glass, application of the Judd-Ofelt theory yielded values of radiative rates, branching ratios, and emission cross sections from the /sup 5/F/sub 1/ manifold. Laser action at 933 and 1098 nm was observed due to the /sup 5/F/sub 1/ → /sup 5/I/sub 5/ and /sup 5/F/sub 1/ → /sup 5/I/sub 6/ transitions, respectively. The calculated thresholds for laser action were in good agreement with experiment. The authors conclude that Pm lasers will perform as well as Nd lasers, both with laser operation blue-shifted to the 920 nm region.

51885 **Spectroscopic characteristics of chromium doped mullite glass-ceramics.** Wojtowicz, A.J.; Meng, W.; Lempicki, A.; Beall, G.H.; Hall, D.W.; Chin, T.C. (Dept. of Chemistry, Boston Univ., Boston, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 1109-1113(Jun 1988).

Characteristics of chromium doped mullite ceramics are discussed with reference to possible laser applications. Dominant features are attributed to large and inherent spectroscopic inhomogeneity of mullite. The spectroscopic data are analyzed using a generalized McCumber theory. The peak stimulated emission cross section is 0.54 x 10/sup -20/ cm/sup 2/. This, together with preliminary single-pass measurements, indicate that gain for mullite is about 2.6 times smaller than gain for alexandrite.

51886 **Laser action of Pr/sup 3+/ in LiYF/sub 4/ and spectroscopy of Eu/sup 2+/ -sensitized Pr in BaY/sub 2/F/sub 8/.** Knowles, D.S.; Zhang, Z.; Gabbe, D.; Jenssen, H.P. (Crystal Physics and Optical Electronics Lab., Massachusetts Institute of Technology, Cambridge, MA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 1118-1123(Jun 1988).

Laser action in flashlamp-pumped Pr:LiYF/sub 4/ at room temperature is observed at 640 nm with a 15 J threshold, but only —0.01 percent slope efficiency. Increased efficiency from sensitizing the Pr with Eu/sup 2+/ is explored in the system Eu,Pr:BaY/sub 2/F/sub 8/. Codoped samples have been grown by the Czochralski growth method, and energy transfer between Eu/sup 2+/ and Pr/sup 3+/ is observed to be very weak. This is probably due to the poor overlap of the Eu/sup 2+/ emission with the Pr/sup 3+/ absorption lines, leading to the conclusion that hosts with a stronger crystal field at the Eu/sup 2+/ site need to be identified.

51887 **Design and performance of a 250 Hz alexandrite laser.** Sam, R.C.; Yeh, J.J.; Leslie, K.R.; Rapoport, W.R. (Military Laser Products, Allied-Signal Corp., Westlake Village, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 1151-1166(Jun 1988).

The design, analysis, and performance of a 250 Hz alexandrite laser are described. Built as the wavelength selective laser for a molecular laser isotope separation program, the laser has to satisfy specifications on its tuning band, linewidth, output energy, temporal behavior, and repetition rate required by the process. The key design feature is the use of a tandem rod oscillator with concave curvature on rod ends for thermal lensing compensation. A model was developed to project the stability range and beam quality relative to repetition rate. The performance results of a delivered system are presented and future developments are discussed.

51888 **Growth and characterization of large Nd, Cr:GSGG crystals for high-average-power slab lasers.** Stokowski, S.E.; Randles, M.H.; Morris, R.C. (Lawrence Livermore National Lab., Livermore, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 934-948(Jun 1988).

Nd,Cr:GSGG crystal boules up t 13 cm in diameter and 20.5 cm long have been grown by the Czochralski method. The authors identified several problems with Nd,Cr:GSGG growth, which they have solved separately but not all at once: spiral boule growth, 1 μm absorption loss, iridium on the melt surface, iridium inclusions, boule cracking, dislocations, and fine scattering ("smoke"). In the grown crystals the authors have measured the following parameters, which will be relevant to their eventual use as gain elements for large slab users: optical homogeneity, birefringence, absorption loss at 1 μm, scattering loss, and iridium inclusions. The optical homogeneity of the boules is good, except for a radial gradient in refractive index of about 10/sup -5/ cm/sup -1/. The birefringence is low (<3 nm/cm) in slab cuts from the boules. Scattering losses measured on small samples are <0.002 cm/sup -1/; absorption losses in the boules range from 0.01 to 0.08 cm/sup -1/. This absorption has been reduced to <0.0025 cm/sup -1/ in small samples using reducing heat treatments, but appropriate treatment conditions for full scale slabs have yet to be determined. Low iridium inclusion densities, <0.01 cm/sup -1/, have been demonstrated in isolated boules; at this inclusion density large gain elements which are entirely inclusion-free should be possible. Additional development is required in order to grow large crystals with the desired quality for laser operation.

51889 **Sideband suppression in free-electron lasers using a grating rhomb.** Tokar, R.L.; McVey, B.D.; Goldstein, J.C. (Applied Theoretical Physics Div., Los Alamos National Lab., Los Alamos, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **24**: No. 6, 856-863(Jun 1988).

In this paper the phase shift produced by a grating rhomb is included in free-electron laser (FEL) pulse calculations to investigate whether or not grating rhombs can be used to suppress the sideband instability. The idea is that because the group travel time through a rhomb is an increasing function of the laser wavelength, an FEL oscillator can be designed such that the optical pulse at a chosen central wavelength and the pulse of electrons overlap spatially when they enter the wiggler. Over many passes, light in a small bandwidth about the chosen wavelength receives the greatest amplification because it overlaps the electrons, and light at sideband instability wavelengths that does not overlap the electrons is suppressed by losses in the oscillator cavity. For a 5 m tapered wiggler like that planned for use in an experiment at the Boeing Aerospace Company, the range in rhomb dispersion and cavity loss that yields acceptable FEL performance is defined. At low values of cavity loss, for example 15 percent, a wide range of rhomb dispersion exists for which both the sideband instability is largely suppressed and the energy extracted from the electrons is high. At large values of cavity loss, for example 30 percent, a critical value for rhomb dispersion exists below which the laser pulse is compressed by the rhomb, leading to reduced energy extraction. As the rhomb dispersion is increased, the effect disappears and the energy extraction increases. The critical point is interplay of the positive chirp acquired by the laser pulse via the FEL interaction in the wiggler and the negative chirp added by the rhomb on each pass.

51890 **Efficiency and sideband observations of a Raman FEL oscillator with a tapered undulator.** Yee, F.G.; Marshall, T.C.; Schlesinger, S.P. (Dept. of Applied Physics, Columbia Univ., New York, NY (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 162-166(Apr 1988).

Power and spectral measurements are reported from the Columbian Raman free-electron laser (FEL) oscillator experiment. High-power radiation pulses (~ 12 MW, 100 ns) are generated to a wavelength of ~ 2.5 mm, using a 750-kV electron beam injected into a helical undulator; the latter is made up of a constant-period (1.45 cm) section 40 cm long followed by an equal length of tapered undulator. The period is decreased by 7.6 percent in such a way that the on-axis field remains constant. The authors find that the taper allows an increase in total power efficiency from ~ 4 to ~ 12 percent. Most noteworthy is that the tapered undulator reduces the sideband radiation compared with a constant-period undulator FEL which was studied in the same configuration. The power was measured calorimetrically and compared with the results of a 1-D Raman code. The reduction of sideband power observed in the experiment was consistent with computational results obtained with a 2-D sideband code.

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REFER ALSO TO CITATION(S) 50489, 50615, 51190, 51318, 51319, 51559, 51560, 51561, 52035, 52051, 52519

51891 **(CEA-R—5439) Experimental and theoretical study of the coagulation of liquid aerosols.** Barbe-Le Borgne, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Technique; Paris-12 Univ., 94 - Creteil (France)). Mar 1988. 222p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754792/JAW.

Coagulation occurs when two aerosols particles in suspension in a gas come into contact and either agglomerate or adhere to one another. A good knowledge of this process governing particle growth is therefore fundamental in order to predict the dynamic behaviour of the aerosol. In particular, the validation of the computer codes for hypothetical accidents modelling in nuclear reactors requires precise information on this process, since there can be production of a large quantity of aerosols released into the environment. Several processes are at the origin of coagulation. In a laminar flow, Brownian motion in the fluid carrier may be responsible for collisions between submicrometer-sized particles. For the biggest particles, the difference between the sedimentation velocities of two particles falling into the gravitation field may bring them together and result in gravitational coagulation. In a turbulent flow the velocity variations within the fluid may affect the particles motions. This results in two main mechanisms: 1) coagulation by turbulent diffusion: the small particles follow the random fluctuations of velocity and may enter into collision; 2) inertial turbulent coagulation due to the difference between fluid and aerosols densities, two particles with different sizes having different response times. Besides, as a collision shall not systematically result in coagulation, collision efficiencies should be determined. A complete theoretical study on the various coagulation processes is developed. The expressions of the various coagulation coefficients proposed in the literature are validated or corrected by an experimental study in some experimental fields (particle size, turbulence intensity...). Collection efficiency is also considered together with the way of summing up the various coefficients.

51892 (INIS-SU—38/A, pp 67-71) **Effect of wall thermal conductivity on the heat transfer process in annular turbulent gas flow for constant wall temperature.** Groshev, A.I.; Anisimov, V.V.; Kashcheev, V.M.; Khudasko, V.V.; Yur'ev, Yu.S. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

The effect of wall material on convective heat transfer of turbulent gas flow in an annular tube with account of longitudinal diffusion both in the wall and in the liquid is studied numerically. The conjugated problem is solved for P/sub r/=0.7 (Re=10/sup 4/-10/sup 6/). Based on numerical calculations it is stated that thermal conductivity of the wall and gas essentially affects the degree of preliminary heating of liquid in the range of a non-heated section. 5 refs.; 4 figs.

51893 (INIS-SU—38/A, pp 76-81) **Effect of phase parameter distribution through channel cross section on the averaged void fraction and condensation process in nonequilibrium bubble flow.** Balakin, P.P.; Kornienko, Yu.N.; Kuzevanov, V.S.; Selivanov, V.M. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

A successive approach to description of two-phase non-equilibrium flow, when phase distribution through the channel cross section is already taken into account at the stage of formulation of one-dimensional conservation equations, is applied. Mass fraction of steam in flow is calculated at tolerance of an experimental profile of averaged underheating of the liquid phase by an axial coordinate. Dependences of continuity and energy necessary for closing the system of differential equations are obtained proceeding from representation of underheated boiling medium as a two-layer flow with saturated two-phase near-the-wall layer. A simple dependence of the condensation function on phase distribution by flow cross section is obtained. Improvement of the description of non-equilibrium bubble flow with account of phase parameter distribution through its cross section is shown based on calculations of condensation in underheated flow on an adiabatic section of the channel and based on comparison with experimental data. 10 refs.; 3 figs.

51894 (INIS-SU—38/A, pp 91-94) **Effect of nonidentity of hydrothermal parameters on the excitation of interchannel pulsations.** Yarkin, A.N.; Kulikov, B.I.; Sudnitsyn, O.A.; Shvidchenko, G.I. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

The results of experimental study of interchannel pulsations (ICP) in the systems of two identical and nonidentical vertical steam-generating channels are discussed. Assumption on the possibility of determining with margin the boundary of ICP ranges in the system of nonidentical channels along the boundary of ICP ranges of one of the channels is shown to be wrong in the general case. Equations describing the boundaries of ICP ranges described by the authors and using only statistical characteristics of the system channels, are presented. 4 refs.; 3 figs.

51895 (INIS-SU—38/A, pp 95-98) **Estimation of determination error of true void fraction according to measured values of average mixture density in thermally nonequilibrium two-phase flow.** Selivanov, V.M.; Boltenko, Eh.A.; Kornienko, Yu.N.; Kochetkova, S.N.; Smirnov, Yu.A. 1987. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780178/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 6.

In Physics and technology of nuclear reactors. Scientific-technical collection.

Probable errors of determining true void fraction using contactless methods (γ-gate, method of moderated neutrons, etc.) are estimated based on experimental data on distribution of true void fraction and temperature of liquid phase in a tube at thermally nonequilibrium two-phase flow. The estimation is conducted by measured values of medium density of mixture and liquid phase on the saturation line, by flow enthalpy in the range of thermally nonequilibrium two-phase flow. Correct determination of the boundary of coolant boiling in the channel and true void fraction in this range require supplementary data on the profile of liquid temperature over the channel cross section. 4 refs.; 3 figs.

51896 (NP—8770351) **Pulsation studies on a rotary piston pump.** Voelklein, J. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Technische Fakultaet). 22 Sep 1986. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88770351/JAW.

Using the example of a rotary piston pump, volume flow pulsation is described as a function of internal gap flow. A computer model is established which can predict the pulsation and pumping characteristics of the pump on the basis of the experimental key data. (HAG).

51897 (NP—8770353) **Dynamics and stability of self-excited, multiple-frequency combustion vibrations - an extended stability criterion.** Lang, W. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 30 Jun 1986. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770353/JAW.

Vibrations inside the combustion chamber are common in many industrial combustion systems. Complex vibrations are investigated in the dissertation. Stability criteria were determined by experiments. The results are discussed, and excitation mechanisms of complex vibration phenomena are investigated. (HAG).

51898 (RISO-M—2690) **Large scale laboratory tests of interfacial friction in stratified two-phase flow.** Kaiser, N.E.; Iversen, S. (Risoe National Laboratory; LICconsult). (Risoe National Lab., Roskilde (Denmark); Lic Consult Raadgivende Ingenioerer A/S, Copenhagen (Denmark); Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). Feb 1988. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754413/JAW.

A combined experimental and theoretical study of the interface friction in two-phase stratified flow has been carried out as a joint project between Risoe National Laboratory, LICconsult Consulting Engineers Ltd. and the Institute of Hydrodynamics and Hydraulic Engineering at the Technical University of Denmark. The experiments have been made in a test rig located at the Technical University. The rig is about 50 m long including a test section of 36 m with an inner diameter of 90 mm. The test section is partly made of transparent tubes, which make it possible to determine the flow regime visually. All experiments have been performed with air/water mixtures at horizontal or near horizontal flow. The inclination of the test section ranging from 0.5 deg. upwards to 1.0 deg. downwards. In total more than 400 combinations of waterflow, airflow and inclination have been investigated. The interfacial friction has been calculated from measurements of liquid and gas velocities, the pressure gradient along the test section and the liquid level in tube. 10 tabs., 46 ills.,

51899 (UCID—21471) **Micro heat pipes.** Olness, D.U. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016113/JAW.

Under the direction of Dr. Tomas Hirschfeld, a preliminary set of experiments was carried out in the spring of 1982 to examine the heat transmitting properties of {open←quotes}micro heat pipes.{close←quotes} The miniaturized heat pipes were observed to conduct heat better than copper wires of comparable size; calculations indicate a potential conductivity four orders of magnitude greater than that of aluminum. The experiments are described and the calculations are presented.

51900 **Effective equation governing convective transport in porous media.** Georgiadis, J.G.; Catton, I. (Department of Mechanical, Aerospace, and Nuclear Engineering, University of California, Los Angeles, CA 90024). *Journal of Heat Transfer;* **110**: No. 3, 635-641(Aug 1988).

The fine structure of disordered porous media (e.g., fully saturated randomly packed beds) causes microscopic velocity fluctuations. The effect of the spatial and temporal randomness of the interstitial velocity field on the convective transport of a scalar (heat or mass) is investigated analytically. For a uniform mean velocity profile, the effective heat transport equation is obtained as the equation governing the transport of the ensemble average of the scalar under conditions of steady or unsteady random fields (with given statistics). In both cases, it is shown that the effective transport coefficient is enhanced by a hydrodynamic dispersive component, which is an explicit function of the mean filtration velocity. The agreement with experiments is encouraging. The effective transport equation is then generalized to three-dimensional mean velocity fields for isotropic media.

51901 **Transition boiling models in heat exchangers.** France, D.M.; Shin, S.K.; Azimi, M.; Shafiei, A. (University of Illinois at Chicago, Department of Mathematical Engineering, Chicago, IL 60680). *Journal of Heat Transfer;* **110**: No. 3, 705-709(Aug 1988).

Models are presented for the inclusion of transition boiling heat transfer in the thermal analysis of liquid-heated boiling water heat exchangers. A relation was developed from experimental data for the prediction of the quality change in the transition boiling region. This quality relation was used alone and in conjunction with a transition boiling heat transfer coefficient to formulate two successful models. Predictions of heat exchanger heat transfer, including the transition boiling models, were compared with experimental results for high-pressure water in the range 7—15.3 MPa over a mass flux of 0.7—3.2 Mg/m^2s.

51902 **Finite-element methods for the streamfunction-vorticity equations: Boundary-condition treatments and multiply connected domains.** Gunzburger, M.D.; Peterson, J.S. (Dept. of Mathematics, Carnegie-Mellon Univ., Pittsburgh, PA (US)). *SIAM Journal on Scientific and Statistical Computing;* **9**: No. 4, 650-668(Jul 1988).

Finite-element methods for the approximation of the solution of streamfunction-vorticity equations are considered. Among the issues dealt with are multiply connected domains, the use of low-order elements, the incorporation of a variety of boundary conditions into the methodology, error estimates, and the recovery of the primitive variables. Various numerical examples are also provided.

51903 **High aspect ratio convection near an inversion layer.** Wilson, G.L.; Rydin, R.A. (Univ. of Virginia, Charlottesville (USA)). *Transactions of the American Nuclear Society;* **55**: 364-366(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

Time-dependent nodal integral methods (TDNIMs) for natural convection were initially developed assuming a linear buoyancy term; they were applied to various bifurcation phenomena and to a brief study of dissipation effects. These methods have now been extended to the study of natural convection in a cavity near a fluid density maximum. Two versions of the TDNIM were developed, and regions of validity were determined. The low-order approach was used here to explore the solution types near a fluid density maximum in the Benard problem with $\beta > 1$. Because the low-order approach was used, the restriction $Ra << 10^6$ applies for the coarse-mesh calculations employed in this study.

51904 **A continuum theory for fiber suspensions.** Lipscomb, G.G.; Keunings, R.; Marrucci, G.; Denn, M.M. (Lawrence Berkeley Lab. (US)). pp 497-504 of Advances in rheology. Volume 2: Fluids. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

A continuum constitutive equation is obtained for suspensions of rigid rodlike fibers in a viscous Newtonian medium, enabling simultaneous calculation of the kinematics, stress distribution, and fiber orientation distribution. A closure approximation in deriving the equation has little effect in flows where an exact solution for the orientation distribution can be obtained. A finite element procedure is developed for the solution of boundary value problems in complex geometries like those encountered in processing. Special care is required because of a near-singularity at solid boundaries where the kinematical no-slip condition is satisfied.

51905 **Dynamics of liquid filament breakup.** Bousfield, D.W.; Marrucci, G.; Denn, M.M. (Lawrence Berkeley Lab. (US)). pp 239-246 of Advances in rheology. Volume 2: Fluids. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

The non-linear growth of surface tension-driven disturbances leading to breakup of a liquid filament is studied, using a one-dimensional approximation of the filament dynamics. The results are consistent with linear stability analyses during the initial portion of the transient, but also enable calculations at long times approaching breakup. Nonlinearities associated with inertial stresses lead to the formation of satellite droplets for Newtonian jets. The retardation of disturbance growth and stabilization of viscoelastic jets at long times is shown to be a consequence of nonlinearities associated with the buildup of large extensional stresses.

51906 **Particle segregation in Poiseuille flow: A continuum mixture theory.** Nunziato, J.W.; McTigue, D.F. (Fluid and Thermal Sciences Dept., Sandia National Labs., Albuquerque, NM (US)). pp 345-352 of Advances in rheology. Volume 1: Theory. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

The segregation of particles in plane Poiseuille flow of a dilute suspension is analyzed. The suspension is described as two-phase, continuum mixture of rigid spherical particles in a Newtonian fluid. The interaction between phases is accounted for through the exchange of momentum and disparate phase pressures which embody buoyancy, drag, lift, and Faxen forces, as well as local inertial effects and Brownian diffusion. Moreover, the additional shearing resistance due to the presence of the particles is not arbitrarily assigned to the fluid phase; rather, this interaction contributes to an extra momentum transport in the mixture which is identified with the Einstein correction to the effective viscosity. For Poseuille flow, the solution for the velocity difference between the fluid and particulate phases shows that the particles lag the fluid with the maximum difference at the centerline. This velocity difference results in forces on the particulate phase toward the centerline due to lift and toward the boundaries due to local inertia. This yields an off-axis maximum in the concentration profile, reminiscent of the Segre-Silberberg effect. The non-uniform particle distribution affects the apparent rheological properties of the suspension.

51907 **Numerical simulation of the flow of an Oldroyd fluid through a periodically constricted tube.** Zick, A.A.; Homsy, G.M. (Arco Oil and Gas Co., Plano, TX (US)). pp 663-668 of Advances in rheology. Volume 1: Theory. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

Convergent numerical solutions are obtained for the stated problem through use of a finite-difference formulation coupled with a new relaxation-based iterative procedure. Results are available for values of the Weissenberg number considerably greater than previously obtained. The results show a monotonic decrease in resistance coefficient, in contrast with observed experimental behavior in constricted tubes and in porous media. Those predictions throw into question the appropriate of spatially-periodic models and Oldroyd models for non-Newtonian flow in porous media.

51908 **A finite element method for a class of viscoelastic flows in deforming domains applied to jet breakup.** Keuings, R. (Univ. of California, Berkeley, CA (US)). pp 699-708 of Advances in rheology. Volume 1: Theory. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

The authors present a numerical method for solving a class of transient viscoelastic flows in domains with free boundaries. It is based on a Galerkin/Finite Element technique combined with a predictor-corrector scheme that allows for the prediction of stress field, velocity field and flow domain as a function of time. The numerical procedure is applied to the analysis of surface-tension-driven breakup of liquid jets. They study the non-linear growth of a periodic disturbance imposed on an infinitely long jet and leading to breakup. In the Newtonian case, the authors predict the birth of satellite drops when inertia forces are present. Results for an Oldroyd fluid show that elasticity accelerates the breakup process at short times, which is consistent with linear stability analyses. How-

ever, this tendency is dramatically reversed at later times when a pattern of drops connected by remarkably stable filaments is obtained. The authors thus predict the stabilizing effect of elastic forces, known experimentally for many years, and show that the breakup mechanism of a viscoelastic jet cannot be described by linearized dynamics.

51909 **The helical screw rheometer.** Kraynik, A.M.; Aubert, J.H.; Chapman, R.N. (Sandia National Labs., Albuquerque, NM (US)). pp 77-84 of Advances in rheology. Volume 4: Applications. Mena, B.; Garcia-Rejon, A.; Rangel-Nafaile, C. New York, NY; Elsevier Science Pub. Co. Inc. (1984). (CONF-841076—).

From 9. international congress on rheology; Acapulco, Mexico (8 Oct 1984).

The helical screw rheometer represents a new concept in viscometry: a rotational instrument that generates a pressure difference and therefore does not require torque measurement. The basic viscometric flow is unique: a superposition of drag and Poiseuille flow. The kinematics and stress distributions are described along with the flow analyses for three generalized Newtonian fluids. Analysis indicates that it may not be possible to obtain the viscosity function from pressure drop and rotation rate data, alone, without simplifying assumptions. Comparisons between theory and experiment are presented.

4205 Materials Testing

REFER ALSO TO CITATION(S) 51058, 51119, 51193, 51383, 51515, 51708

51910 **(EPRI-NP—5979) Wave-propagation studies for improved ultrasonic testing of centrifugally cast stainless steel.** Rose, J.L. (Electric Power Research Inst., Palo Alto, CA (USA); Drexel Univ., Philadelphia, PA (USA). Dept. of Mechanical Engineering and Mechanics). Aug 1988. 117p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016703/JAW.

Difficulties in the inspection of certain piping materials in the nuclear industry can come about as a result of unusual grain structure resulting from different manufacturing procedures. In centrifugally cast stainless steel, for example, grain structures of either fine or coarse grained equiaxe, or columnar-dentritic can be found. This grain structure leads to material anisotropy, which unfortunately changes were velocity in the materials as a function of angle. As a result, basic aspects of wave propagation and wave interference phenomenon are changed, leading to changes in energy velocity, beam skewing, beam splitting, unsymmetrical field profiles, unusual side lobe formations, unusual focusing and divergence etc. all causing errors in reflector detection, location, classification, sizing, and in overall imaging. Even for mild cases of anisotropy, severe beam distortion can occur. In satisfying the program goal of advancing the state-of-the-art in the ultrasonic NDE of piping materials, we launch a two phase program. The first is associated with material characterization efforts. Once this is accomplished, phase two becomes possible, this phase being associated with optimal penetrations and inspection through a known material for reliable reflector detection and analysis. 25 refs., 36 figs.

51911 **(INIS-mf—11295) Radiographic evaluation for inspection of steel casting and welding parts.** Bilge, A.N.; Tugrul, B. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1986. 11p. (In Turkish). (CONF-8610433—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703913/JAW.

From Industrial cooperation in the field of nuclear technology; Istanbul, Turkey (15 Oct 1986).

Evaluation of the radiographs is an important stage of the radiography technique. In this study,the basis of the evaluation are defined and related international references are given with examples. Radiographic inspections for steel casting and welding parts are expanded applications. In Turkey,industrial quality controls are realized mostly on this type of the materials. The important points and different types of the discontinuities are explained with some radiographs.

51912 **(INIS-mf—11805) Combining stray flux and ultrasonic testing into a novel technique for dimension and fault detection in pipes and bars. Final report. Reporting period July 1, 1982 - December 31, 1984.** Ruth, U.; Hueschelrath, G. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1985. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754839/JAW.

The equipment explained is a rotating device for combined stray flux and ultrasonic testing of pipes and bars with outer diameters between 50 mm and 180 mm. It can be applied for defect detection and dimensional controls, with only one magnetic field being required for both measuring techniques. The report explains in detail the coils developed for this device, the yoke, the removable pole pieces, and the electronic equipment.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 51707, 51719, 51831

51913 **(BDX—613-3939) Statistical modeling of electrical components: Final report.** Jolly, R.L. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Jul 1988. Contract AC04-76DP00613. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014217/JAW.

A method of forecasting production yields based on SPICE (University of California at Berkeley) circuit simulation and Monte Carlo techniques was evaluated. This method involved calculating functionally accurate component models using statistical techniques and using these component models in a SPICE electrical circuit simulation program. The results of the simulation program allow production yields to be calculated using standard statistical techniques.

51914 **(DOE/CE/15324—T5) Component: Dimmers, commercial: [Final technical progress report, February 1, 1988-April 30, 1988].** (Varigas Research, Inc., Timonium, MD (USA)). 20 Apr 1988. Contract FG01-87CE15324. 27p. Varigas Research Inc., P.O. Box 489, Timonium, MD 21093. Order Number TI88009663/JAW.

This report reviews an electric fluorescent lamp dimmer by Underwriters Laboratories. Design and safety features are investigated. (LSP)

51915 **(GEPP-TIS—1084) Component inspection study using the corneal reflection eye tracker.** Kunak, D.V.; Beetley, D.E.; Foster, S.; Heusack, L. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 25 Jul 1988. Contract AC04-76DP00656. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014184/JAW.

The implementation of Military Standard (MIL-STD) 1567A, requires development of "Type I" work measurement labor standards for inspection processes. The systems used in the development of predetermined time standards which address the visual inspection process are limited. As a result, a study was performed to investigate the influence of form, type, and component enlargement on inspection results obtained during the time required for inspection, the accuracy of error detection, and the number of eye fixations which occur during inspection of a given part. The data obtained from this study indicate that an optimum magnification exists which will produce the most accurate inspection results. There also appears to be a trade-off between the number of fixations and inspection time on the one hand and number of detected errors on the other hand, suggesting that a knowledge may lead to improvements in work design which will reduce operator fatigue as well as improve the quality of and reduce the time required for product inspection. 4 refs., 6 figs.

51916 **(ORNL/TM—10886) Evaluation of new metal-insulator-semiconductor varistor: Final report.** Modine, F.A. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015708/JAW.

A new, composite varistor material containing a metal, an insulator, and a semiconductor was evaluated. Although other constituents can be substituted, the materials that were investigated contained varying proportions of nickel metal, silicon dioxide, and silicon carbide in a silicon rubber binder. The material has rubber-like flexibility and is easily formed into complex shapes. A higher leakage resistivity ({approximately}10^{12} ohm cm) and greater nonlinearity ({approximately}10) than for commercial silicon carbide varistors will permit the material to be used as a gapless surge suppressor. The breakdown voltage (1 kV/cm-10 kV/cm) and other properties of the material vary with composition. High-current capability (>200 A/cm^2) and good energy absorption (>40 J/cm^3) are found. The material exhibits a low-temperature coefficient ({approximately}4 x 10^{-3}/K) and a low dielectric constant ({approximately}10) with no observed loss peak. These dielectric properties are suited to high-frequency applications, such as antenna protection. The material has a response time (<1 ns) that should provide some protection against fast pulses generated by nuclear and directed-beam weapons. At this stage, the physics of the material are mostly conjecture, but the electrical conduction is almost certainly controlled by grain-boundary barriers. However, the conduction is not thermally activated, and it probably has a percolative character. The material will not replace zinc oxide varistors at this time, but it will find specialized applications in which its flexibility, formability, and frequency response are advantageous. 8 refs., 12 figs., 2 tabs.

51917 **(SAND—88-2152C) The standardized Bauer piezoelectric polymer shock gauge.** Graham, R.A.; Bauer, F.; Lee, L.M.; Reed, R.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-8809109—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014963/JAW.

From Shock wave symposium; Pullman, WA, USA (1 Sep 1988).

Earlier reports have described work to establish feasibility for a shock-compression, stress-rate or stress gauge based on a high quality polymer film, polyvinylidene difluoride (PVDF). We have now established standardized procedures to provide large quantities of PVDF guage elements with highly reproducible electrical characteristics based on the process developed by Bauer. (The standard remanent polarization of a group of 100 gauges centered around a mean of 9.1 microcoulombs per square centimeter showed a standard deviation of 0.83 %.) We have also carried out piezoelectric response measurements of standardized guage elements from 300 MPa to 46 GPa. Based on these measurements, it is now clear that the guage provides the capability to carry out time-resolved stress pulse measurements over a broad stress range. Unlike gauges utilizing piezoelectric crystals, the 25 micron thickness of the Bauer piezoelectric polymer gauge provides for unobtrusive and highly versatile gauge locations. The ability to provide a direct measure of stress-rate provides an unusually sensitive record of stress pulses. 7 refs., 1 tab.

51918 **High voltage capability electrical coils insulated with materials containing SF/sub 6/ gas.** Lanoue, T.J.; Zeise, C.L.; Wagennar, L.; Westervelt, D.C. (to Dept. of Energy, Washington, DC). US Patent 4,751,488. 14 Jun 1988. Filed date 4 Jun 1981. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A coil is described comprising layers of adjacent metal conductor windings subject to voltage stress therebetween. The windings have at least one layer of cured resin insulation therebetween. Each layer of the cured resin insulation has been applied as a liquid resin and necessarily containing minute voids therein disposed throughout its cross-section and constituting a small volume percent of the resin insulation; voids within layer cross-sections being filled with SF/sub 6/gas to displace air before substantial resin cure, the SF/sub 6/gas being present in the voids in an amount effective to provide a high level of corona extinction between the conductors.

51919 **High power microwave generator.** Minich, R.W. (to Dept. of Energy, Washington, DC). US Patent 4,751,429. 14 Jun 1988. Filed date 15 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A device, that operates in a vacuum of about 10/sup -5/Torr or less, for producing high-powered and coherent microwaves is described comprising: a cylindrical and hollow real cathode, of radius r/sub c/, for field emitting relativistic electrons in a generally inward radial direction; a cylindrical and substantially electron-transparent anode, of radius r/sub a/, internally and co-axially disposed within the cylindrical real cathode; a cylindrical electron collector electrode; means for rapidly driving the cylindrical anode to a positive potential.

51920 **Ternary gas mixture for diffuse discharge switch.** Christophorou, L.G.; Hunter, S.R. (to Dept. of Energy, Washington, DC). US Patent 4,751,428. 14 Jun 1988. Filed date 14 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A gas mixture is described comprising: a conducting gas that does not readily attach electrons; an insulating gas that readily attaches higher energy electrons; and a third gas having an ionization potential sufficiently low that it can release electrons upon collision with atoms of the conducting or insulating gas when in an excited electronic state; wherein the gases are present in suitable proportions to maximize current and maintain sufficient insulation properties to protect the switch from voltage damage.

4209 Waste Processing Plants And Equipment

51921 **(DP-MS—88-161) Glovebox waste accountability improvements.** Gupta, P.K. (Du Pont de Nemours (E.I.) and Co., Newark, DE (USA). Engineering Dept.). 1988. Contract AC09-76SR00001. 12p. (CONF-880846—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015684/JAW.

From American Glovebox Society annual meeting; Denver, CO, USA (23 Aug 1988).

Fissile glovebox waste is a large contributor to the annual accountability uncertainty in FB-Line of the Savannah River Plant. Installation of a glovebox facility has been proposed to significantly improve this accountability. Proposed facilities include a robot for waste sorting, high pressure Freon* spray cleaning system to remove plutonium particles form non-combustible waste, an incinerator to recover Pu in form of a low fired ash, a bagless drum transfer system, and the required assay monitoring instrumentation to eliminate sources of accountability error. This paper summarizes the provisions that are planned to improve assay of FB-Line waste forms, reduce waste volume and minimize personnel radiation exposure. 1 ref., 6 figs.

51922 **(KIRI—8601, pp 11-12) Research on technology of effective utilization of organic industrial wastes.** Ikariya, Michio; Tanaka, Hideo; Konjo, Satoshi; Asami, Kiyoshi. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). 15 Oct 1986. (In Japanese). Industrial Research Inst. of Kanagawa Prefecture, 3173, Showamachi, Kanazawaku, Yokohama, Japan.

In Materials of Research Results in Fiscal Year 1986.

Recently, securing reclaimed land for industrial wastes disposal has become difficult and it is becoming necessary to reduce the volume of wastes by proper treatment thereof. Consequently, a research was started from 1984 with the objectives of providing solutions to such matters as 1) feasibility of bunch treatment of the wastes, 2) establishment of a large rate of volume reduction, 3) cheap installation and operation costs, and 4) feasibility of stable storage of the product and its reutilization as resource. As test materials, plastic, sawdust, and paper, etc. were used independently or in mixture. When lignum was thermally decomposed at 400-500°C, the yield of carbide became 30% and the rate of volume reduction became 1/30-1/12. Thus it seemed sure to utilize the produced gas and oil components as the heat sources for thermal decomposition. When lignum was mixed with plastic, the volume of produced gas became increased and the calorific value became higher. Accordingly further feasibility of utilization is expected. If the produced carbide becomes homogeneous and stabilized, the usage other than fuel may hopefully start. (3 figs, 2 tabs)

51923 (KIRI—8601, pp 9-10) **Heat recovery from waste steam, case of dyeing factory.** Chiba, Shozo; Murai, Shoji. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). 15 Oct 1986. (In Japanese). Industrial Research Inst. of Kanagawa Prefecture, 3173, Showamachi, Kanazawaku, Yokohama, Japan.

In FY 1986 Gyoseki Shiryo.

In the fixing process at a dyeing factory, the heat of waste steam which had been released so far could be recovered and reutilized efficiently and economically. In the fixing process, two steamers are necessary since the cloth is required to contact the high pressure steam and the low pressure steam respectively, but the waste steam from the low pressure steamer had been released outdoors. This time, a heat recovery device was installed and the exhaust steam from the steamer concerned was connected thereto. Then, latent heat of the steam was once recovered as hot water sensible heat through indirect cooling and thus recovered hot water was used as boiler feed water. Because of this, consumption of kelosine was considerably saved. Furthermore, since this system does not change the production processes, it is applicable for any process and any kind of steam and a good energy saving effect can be expected. (2 figs)

51924 **(KIRI—8601) FY 1986 Gyoseki Shiryo.** (Industrial Research Inst. of Kanagawa Prefecture, Yokohama (Japan)). 15 Oct 1986. Vp. (In Japanese). Industrial Research Inst. of Kanagawa Prefecture, 3173, Showamachi, Kanazawaku, Yokohama, Japan.

Individual papers from the document are separately indexed for EDB. (BCS)

51925 (KIRI—8601, pp 7-8) **Thermal energy recovery by wet oxidation reaction process.** Mori, Osami; Adachi, Fumio; Wakakura, Masahide; Yasuda, Makoto; Makano, Shin'ichi. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). 15 Oct 1985. (In Japanese). NTIS (US Sales Only), PC A02/MF A01 - Available from Industrial Research Inst. of Kanagawa Prefecture, 3173, Showamachi, Kanazawaku, Yokohama, Japan.

In FY 1986 Gyoseki Shiryo.

Conditions for improving the reactivity of phenol solution by using several catalysts and applicability of the wet oxidation reaction process to waste oil were studied. As the catalysts, cuprous oxide and cupric oxide, ruthenium oxide, ferric oxide, manganese oxide, and cobalt oxide were used. As for the waste oil, mineral oil, soluble type water soluble cutting oil, and emulsion type water soluble cutting oil were used. 1) In the atmosphere of normal temperature and pressure, improvement of the performance of the wet oxidation process was observed by the use of catalysts to phenol which is hard to be oxidized. 2) Recovery of thermal energy from wastes oil is feasible, but the treatment of antioxidant presents a problem. 3) In case that air-liquid contact is made through mechanical stirring, it becomes necessary to make more minute the bubbles from the bubble generating nozzle in order to improve reactivity. (4 figs, 2 refs)

51926 **Incineration - some things I would like to know about and why.** Shaub, W.M. pp 98 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Many issues which can affect the development of waste-to-energy technology are related to research concerned with the science of incineration and the issue of how to relate results obtained from laboratory or pseudo-full scale experiments to data taken from emissions measurements on actual operating incinerators. It is important to be able to do this in order to determine options for minimizing emissions of potential pollutants and in order to be able to communicate credible and readily understood information to the public. This talk addresses some of these issues and also touches on public concerns that provide feedback to the scientific community about what information and therefore what research might be important to develop and interpret. Some of the discussion may focus on how the absence of data has affected people's perceptions about the viability of waste-to-energy technology.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 51897, 52443

51927 **(AUC-IFE-LT—87-01) Circulating fluid bed - cold test. Part 1.** Fugl, A.W. (Aalborg Universitetscenter (Denmark). Inst. for Energiteknik). Jun 1987. 106p. (In Danish). Aalborg Universitetscenter, Institut 14, Pontoppidanstraede 101, DK-9220 Aalborg Oest.

A model describing the solids flow in the vessel of a circulating fluidized bed using statistical mechanics has been established. A cross section average version of Boltzmanns transport equation is solved, using relaxationtime-technique and linear approximations, concerning the external forces, of the deviation of the distribution function from thermal equilibrium. The drag-force on a particle is described by a corrected Stokes-coefficient. This model is compared with data from experiments by the author together with two other models, one of which is based on kinematic gas-theory and the other on an empirical correllation proposed by M. Kwauk. The experimental part consists of measurements on a 5.5 m high cold model of a circulating fluidized bed with a diameter of 0.22 m. During a typical test, the distribution of pressure and temperature in the vessel and the flow of air and solid is measured. Four mixtures of sand different size-distributions were used, and for each mixture, measurements consisting of different combinations of fluidization velocities, 2-8 m/s, and pressure drop across the part of the vessel of current interest, 25-100 mbar, were done. The model using kinetic gas-theory is rejected, because computations compared to the measured data either are undefined or reveal poor agreement. Both the Kwauk-model and the statistical mechanics model are adapted to the experiments using a correction factor. If these corrections are known, then the statistical model predicts the distribution of pressure - and with that the axial distribution of solids - with a greater accuracy, than does the model of Kwauk. There is a good agreement between the main mechanisms in the theoretical model using statistical mechanics and the experiment. The statistical model, which rests on a more direct physical basis compared to Kwauks, can be used for selecting registrations of data with reference to mapping empirical correlations. 56 refs.

51928 **(AUC-IFE-LT—87-02) Circulating fluid bed - cold test. Part 2.** Fugl, A.W. (Aalborg Universitetscenter (Denmark). Inst. for Energiteknik). Jun 1987. 216p. (In Danish). Aalborg Universitetscenter, Institut 14, Pontoppidanstraede 101, DK-9220 Aalborg Oest.

A model describing the solids flow in the vessel of a circulating fluidized bed using statistical mechanics has been established. A cross section average version of Boltzmanns transport equation is solved, using relaxationtime-technique and linear approximations, concerning the external forces, of the deviation of the distribution function from thermal equilibrium. The drag-force on a particle is described by a corrected Stokes-coefficient. This model is compared with data from experiments by the author together with two other models, one of which is based on kinematic gas-theory and the other on an empirical correllation proposed by M. Kwauk. The experimental part consists of measurements on a 5.5 m high cold model of a circulating fluidized bed with a diameter of 0.22 m. During a typical test, the distribution of pressure and temperature in the vessel and the flow of air and solid is measured. Four mixtures of sand of different size-distributions were used, and for each mixture, measurements consisting of different combinations of fluidization velocities, 2-8 m/s, and pressure drop across the part of the vessel of current interest, 25-100 mbar, were done. The model using kinetic gas-theory is rejected, because computations compared to the measured date either are undefined or reveal poor agreement. Both the Kwauk-model and the statistical mechanics model are adapted to the experiments using a correction factor. If these corrections are known, then the statistical model predicts the distribution of presssure - and with that the axial distribution of solids - with a greater accuracy, than does the model of Kwauk. There is a good agreement between the main mechanisms in the theoretical model using statistical mechanics and the experiment. The statistical model, which rests on a more direct physical basis compared to Kwauks, can be used for selecting registrations of data with reference to mapping empirical correlations.

51929 **(AUC-IFE-LT—87-03) Circulating fluid bed - cold test. Part 3.** Fugl, A.W. (Aalborg Universitetscenter (Denmark). Inst. for Energiteknik). Jun 1987. 116p. (In Danish). Aalborg Universitetscenter, Institut 14, Pontoppidanstraede 101, DK-9220 Aalborg Oest.

A model describing the solids flow in the vessel of a circulating fluidized bed using statistical mechanics has been established. A cross section average version of Boltzmanns transport equation is solved, using relaxationtime-technique and linear approximations, concerning the external forces, of the deviation of the distribution function from thermal equilibrium. The drag-force on a particle is described by a corrected Stokes-coefficient. This model is compared with data from experiments by the author together with two other models, one of which is based on kinematic gas-theory and the other on an empirical correllation proposed by M. Kwauk. The experimental part consists of measurements on a 5.5 m high cold model of a circulating fluidized bed with a diameter of 0.22 m. During a typical test, the distribution of pressure and temperature in the vessel and the flow of air and solid is measured. Four mixtures of sand of different size-distributions were used, and for each mixture, measurements consisting of different combinations of fluidization velocities, 2-8 m/s, and pressure drop across the part of the vessel of lcurrent interest, 25-100 mbar, were done. The model using kinetic gas-theory is rejected, because computations compared to the measured data either are undefined of reveal poor agreement. Both the Kwauk-model and the statistical mechanics model are adapted to the experiments using a correction factor. If these corrections are known, then the statistical model predicts the distribution of pressure - and with that the axial distribution of solids - with a greater accuracy, than does the model of Kwauk. There is a good agreement between the main mechanisms in the theoretical model using statistical mechanics and the experiment. The statistical model, which rests on a more direct physical basis compared to Kwauks, can be used for selecting registrations of data with reference to mapping empirical correlations.

51930 **(DOE/ID/12463—2) Development of spectral flame analyzer for individual burner control in boilers: Final report.** Metcalfe, C.I.; Cole, W.E. (TECOGEN, Inc., Waltham, MA (USA)). Nov 1987. Contract AC07-83ID12463. 104p. NTIS, PC A06. Order Number DE88016692/JAW.

Optimum continuous combustion control of a multiple burner system can be achieved only if each individual burner can be continuously checked. The most promising method to achieve individual control is based on spectral emission from each burner flame. The intensity of certain emissions from chemical species formed during combustion are indicative of the fuel-air ratio of the burner. An optical monitor tuned to these emission bands provides the needed burner control signal. Tests were conducted to develop this technology. The first tests were conducted using laboratory scanning radiometers to look at the spectral emissions. These tests clearly showed the active wavelength bands and how the intensity varied with excess air level, firing rate, swirl, and fuel type. This information was used to upgrade a prototype analyzer previously built and tested. This analyzer was installed on a 1000-lb/hr package boiler and operated for four months. Results showed a response to excess air level, swirl, and firing rate.

51931 **(STU—83-4632) Calculations of the thermal radiation in combustion chambers - a computer model.** Fransson, C. (Foersvarets Forskningsanstalt, Stockholm (SE). Avd 2). (Swedish National Board for Technical Development, Stockholm). 25 May 1987. 47p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88754447/JAW.

A computer code was written for calculation of the radiant heat transfer in a combustion chamber of cylinder or box form, filled with an absorbing and scattering mixture of carbon dioxide, steam, soot and fuel particles at atmospheric pressure. Calculations for turbulent flames of natural gas without soot show good agreement with experimental data for small flames (0.12MW). For larger flames (3MW) the differences increase. These differences can be caused by the simplified treatment of the radiation properties of the carbon oxide and the steam. For turbulent pulverflames, the model gives values of the same order of magnitude as the experimental results. No evaluation of the usefulness of the model has been done, due to the lack of experimental data. The model can be generalized to geometrically complex combustion chambers with radiation properties varying with the wavelength. (L.E.).

51932 **(STU—86-4794) Generic method for indirect determination of boiler efficiency through fuel and gas analysis.** Asplund, F. (Scandiaconsult AB, Stockholm (SE)). (Swedish National Board for Technical Development, Stockholm). 12 Apr 1987. 46p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754455/JAW.

By connecting material- and energy balances an explicit indirect determination of the boiler efficiency is made. The need for power measurement of the fuel supply disappears, which means that the precision of the power measurement is of minor importance. Beside the determination of the calorific value of the fuel and the heat losses, the efficiency is a function of the results of the fuel, ash, flue gas and oxidizing agent-analyses. The method is simple and accurate, and independent of fuel, boiler or combustion equipment. (L.E.).

51933 **Fate of light hydrocarbon components in contaminated solids subjected to rotary kiln incineration.** Lighty, J.S.; Owens, W.D.; Silcox, G.D.; Pershing, D.W.; Cundy, V.A. (Univ. of Utah, Salt Lake City (USA)). pp 68-71 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Incineration has proven to be a permanent solution for many solid waste disposal problems minimizing future cradle-to-grave liabilities. Recent pioneering work by Linak et al has demonstrated the importance of transient puffs in a rotary kiln environment. The Department of Chemical Engineering at the University of Utah currently has a major research effort underway to characterize the rate limiting steps in optimizing incineration of hazardous solid waste materials including incinerable solids, spent sorbents and contaminated soils in a rotary kiln environment. The combined experimental and theoretical approach is based on the concept that the solid charge in a rotary kiln can be viewed as a bed composed of many layers of particles that are being slowly stirred. The experimental approach simplifies the complicated effects in a rotary kiln environment by first exploring the fundamental transport phenomena within particles and then within beds using two reactors. The experimental studies are supported by computer modeling of the desorption and diffusion processes within the bed and of the radiant, convective, and conductive heat transfer within the kiln. This paper specifically focuses on one portion of a study being conducted in conjunction with Louisiana State University and Dow Chemical Company. The overall goal is to develop a rudimentary understanding of and a predictive capability for rotary kiln design. This paper explicitly examines the results obtained with the fundamental bed reactor and the laboratory scale simulator which have focused on the evolution of toluene from a sorbent material (Supersorb).

51934 **Repowering with coal gasification and gas turbine systems: an acid rain control strategy option.** Bajura, R.A.; Ludlow, J.C. (Morgantown Energy Technology Center, WV (USA)). pp 192-195 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

A study has been completed assessing the addition of coal gasifiers and a gas turbine to an existing coal-fired, steam turbine generating unit as an acid rain control technology option. This study considers the case where a utility needs new electrical generating capacity. A scenario is examined in which a steam turbine unit with uncontrolled SO_2 emissions is repowered with new coal gasification and gas turbine systems. Hot gas cleanup processes are utilized to remove sulfur and particulate contaminants from the fuel gas produced by air-blown, fluidized-bed coal gasifiers. The existing steam turbine is refurbished and becomes part of a bottoming cycle for the gas turbine. However, the boiler is replaced with a new heat recovery steam generator (HRSG) which uses the energy

available in the gas turbine exhaust to produce 1000°F, 1465 psia steam for the non-reheat steam cycle. The coal gasification plant configuration used in this study is similar to that which will be used in the 60-MWe Appalachian Project to be built as part of the Department of Energy's (DOE) Clean Coal Technology Program. US electric utilities have a sizable inventory of potential repowering candidates - coal-fired units that are 20 or more years old and have uncontrolled SO_2 emissions. The steam turbines in units of this vintage often have many remaining years of useful life. The boilers, however, may be near the end of their useful (i.e., reliable) lives. Therefore, a scenario which involves replacing the existing boiler with a new HRSG is a logical repowering approach.

51935 **Developing technology for the abatement of flue gas emissions.** Pennline, H.W.; Joubert, J.I. (Pittsburgh Energy Technology Center, PA (USA)). pp 205-208 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

The US Department of Energy's Flue Gas Cleanup Program supports the development of postcombustion flue gas cleanup technology. The goal is to foster the more widespread use of coal by providing the technology necessary for its utilization in an environmentally and economically acceptable manner. Presently, the research and technology development activities are divided into five areas: Combined SO_2/NO/sub x/ Removal, SO_2 Control, NO/sub x/ Control, Fine Particulate Control, and Small-Scale Boiler Emission Control. Projects in the general DOE Flue Gas Cleanup Program are conducted by in house research groups at the Pittsburgh Energy Technology Center (PETC), by universities, by national laboratories, and by industrial organizations. The in-house projects conducted at PETC parallel nearly all areas of the overall DOE program. Descriptions of the six PETC flue gas cleanup projects are given.

51936 **Removal of NO/sub x/ and SO_2 from flue gas using oxidizing compounds.** Littlejohn, D.; Chang, S.G. (Lawrence Berkeley Lab., CA (USA)). pp 209-210 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—). Contract AC03-76SF00098.

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Sulfur dioxide and nitrogen oxides in flue gas from combustion-based power plants can be converted to acids in the atmosphere and can contribute to the acid rain problem. A number of methods have been developed to reduce emissions of these pollutants. Most processes are designed primarily to remove SO_2, which is usually present in higher concentrations than NO/sub x/ and easier to remove. A method to simultaneously remove SO_2 and NO/sub x/ is desirable. However, many simultaneous desulfurization and denitrification processes are oxygen sensitive, and require a regeneration step to reactive the material used. They have found that a class of oxidizing compounds is capable of removing significant amounts of sulfur dioxide and nitrogen oxides from simulated flue gas. Since the compounds are oxidants, oxygen has essentially no effect on absorption capacity. The compounds have been tested in both a wet scrubbing system and a spray drying system. The chemistry of this system is described in detail and the scrubbing solution preparation and reaction products are discussed.

4220 Underground Engineering

51937 **(CRIE-U—86035) Verification of earthquake resistance analysis of underground cavern.** Komada, Hiroya; Honjo, Shizumitsu; Hibino, Satoshi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Apr 1987. 27p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770174/JAW.

Blasting vibration measurements and analysis on the behavior of the underground tunnel have been carried out for the purpose of simulating the behavior of an underground cavern during an earthquake. (1) A tunnel was excavated in tertiary pyroclastic rocks, having the size of about 11 m in diameter and 60 cm of lining concrete thickness, and the blasting charge amount was 50 - 800 kg with the distance of 150 - 500 m from the tunnel. (2) Behavior of the tunnel against blasting vibration was not so irregular at each side of the tunnel. In other words, the behavior of the tunnel cavern shows a deformation which follows the wave vibration in the rocks. (3) In the comparison of the measured and analyzed values, two-dimensional dynamic finite element method, dynamic boundary element method, and static analysis method were employed. The wave shape and phase of response acceleration and lining strain were comparatively identical in all methods. (22 figs, 3 tabs)

51938 **(NAGRA-NTB—86-07) Exploration well Riniken. Construction work and environmental aspects, drilling technologies.** (Nationale Genossenschaft fuer die Lagerung Radioaktiver Abfaelle (NAGRA), Baden (Switzerland)). Feb 1988. 173p. (In German). Nagra, CH-5401 Baden, Switzerland.

The exploration well at Riniken was realized as the third well within the Nagra Deep Drilling Program in Northern Switzerland. The drilling work was started June 23, 1983. Having reached the final depth of 1800.5 m on January 13, 1984 the test phase was then initiated and completed by July 23, 1985. The well drilled approximately 1800 m of sediments. Oriented cores were taken over the major part of the well. The expected crystalline rock was not reached. The present report presents the drilling activities, civil construction work related to the site and precautions taken to account for environmental protection aspects. A chapter dealing with the commission representing members of the federal, cantonal and local authorities and reporting is given at the end of this report. (author) 29 figs., 47 tabs.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 51692

51939 **(CE—8710) Fatigue performance of repaired tubular joints.** (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1987. 158p. (MICROLOG—88-03143). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $0.34 CAN per page, $3.40 minimum; MF $10 CAN.

This report describes a series of fatigue tests on welded tubular T joints in steel as found in offshore structures, in which fatigue cracks were repaired by a number of alternative methods. The principal objectives were to establish a ranking for the repair methods in terms of residual fatigue performance and to establish whether it is necessary to repair the entire joint, or only the cracked region. The joints were tested in out-of-plane bending. The repair methods were repair welding, repair welding and burr grinding, hole drilling and core expansion and grinding alone. Repair welding was carried out in air at atmospheric pressure under shop conditions. In a subsidiary investigation, fatigue cracks growth rates were measured in weld metal deposited under hyperbaric conditions to establish whether hyperbaric welds would give similar results. The principal findings include the following. The fatigue strength of as-welded repair welds is marginally lower than that of unrepaired joints. However, this is compensated by the fact that in making the repair, the overall weld leg length is increased. Burr grinding the weld may considerably improve the fatigue strength; through-thickness and part-wall weld repairs behave similarly. Cold expansion holes at the crack tips were not effective as a means of delaying crack propagation. Removal of part-wall flaws by grinding is an effective repair method giving endurances after repair equal to or up four times greater than the mean for unrepaired joints. It is necessary to burr grind the repaired weld toes on both the chord and the brace to avoid premature failure. The crack growth rates in hyperbaric welds would be expected to be similar to those in the one-atmosphere repairs studied here. 12 refs., 150 figs., 13 tabs.

51940 **(CMD—TP6028E) Kigoriak & Robert Lemeur, 1983 full scale ice impact tests. 2 Vols.** (Canadian Marine Drilling Ltd., Calgary, Alberta). Feb 1985. 477p. (CE—01867). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

The main objective of this project was to gain a better understanding of icebreaker behavior during ramming, using data collected from two Canadian ships and with reference to computer models. The major task in this experiment was the estimation of the global bow force time history, achieved by measuring the ship response. As this response is dynamic, large amounts of data had to be collected in a very short time period. The experimental design, as detailed in this report, centered on the location and type of instrumentation to measure ship response, and the data acquisition system. The bow force was calculated subject to significant difficulties in extrapolation of the shear force curve, local vibration and structural effects, and the methodology used. It was observed that all rams show peak values of bending moment occurring in a narrow range of rise times, approximating the first mode period of ship vibration. An apparent dynamic magnification factor was determined, based on comparing the bending response at initial impact and at the beached condition. The calculated values of the surge added mass show considerable scatter with values in excess of those based on an empirical formula. The values change with time and are dependent on the coefficient of friction. Two measurements were made relating to the determination of ice global failure criteria: ice stresses in line with, and floe accelerations caused by, ship impact. The strain measurements showed high strain rates but are not believed to be representative of the global stress field. 21 refs., 249 figs., 80 tabs.

51941 **(CMD—TP6813E) Kigoriak and Robert Lemeur 1983 ice impact tests. Refinement of model, ship/ice interaction energies. Final report.** (Canadian Marine Drilling Ltd., Calgary, Alberta). Sep 1985. vp. (CE—01868). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

This report examines the role of ice in ship/ice interaction by an investigation based on the conservation of energy throughout the ramming of ice, using data from impact tests by a Canadian icebreaker. The research involved deriving mathematical models to define the physics of the ship/ice interaction, analyzing icebreaker data, and summing the various energies occurring during the interaction to see if energy is conserved at key points during the ram. Energies identified and investigated in this report include kinetic, potential, strain, friction, and crushing energies. The analysis of ship data has shown that it is possible to determine time histories of the ship energies throughout the ram, but the results are sensitive to ship speed and position and the added mass factor selected. Extensive analysis done on ice crushing, friction, and global ice strain energies provided further insight into the mechanics of the interaction and the formulas developed for the interaction physics. It became apparent that development of an interaction model would be best; the knowledge gained from development of energy formulas was used in the model to predict the forces, ship motions, and energy balance based on a simplified geometric representation of the ship. The model was exercised for 5 rams, based on 5 full scale rams, and data were compared at four key points in the ram cycle. The interaction model has proved to show the distributed energies at each stage of the impact, being able to retropredict the full scale initial impact bow force to within 25% over a range of speeds and closely models the motion of the ship. 77 refs., 256 figs., 30 tabs.

51942 (DTH-ISVA-PR—66, pp 35-38) **Calculation of optimal dimensionless coefficients for Ralston's Plastic Limit analysis approach to determination of sheet ice loads on conical structures.** Thunbo Christensen, F. (Inst. Hydrodyn. and Hydraulic Eng. Tech. Univ. (DK)). Feb 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88770387/JAW.

In Progress report.

The commonly used formulas derived by Ralston for determining sheet ice loads on conical offshore structures involve six dimensionless coefficients. Usually, these are given in graphs. The present report very briefly outlines how these coefficients can be determined in a semi-analytical way. (EG).

51943 **(DTH-ISVA-Series Pap.—43) Turbulent wave boundary layers.** Justesen, P. (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). Aug 1987. 241p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88754394/JAW.

Unsteady turbulent boundary layer flow is studied theoretically in different contexts using turbulence modelling techniques. The necessary boundary layer equations for turbulent flow are derived, and a resume of existing models for turbulent flow is given as to forming a basis for the study. The existing literature on turbulent wave boundary layer flow is reviewed with special emphasis on the latest developments within the field of the turbulence modelling, and the notion of a "pertinent" model for practical purposes is discussed. The backbone of the report is a thorough, theoretical investigation of the oscillatory turbulent boundary layer developing over a horizontal bed. Models for this flow problem are presented for the three wall types: rough, smooth, and transitional walls. A comprehensive discussion of the results based on a comparison with experimental data is included. The one-equation model in general and the two-equation model of turbulence in particular are shown to give good predictions for mean-flow quantities as well as for the turbulent quantities as turbulent kinetic energy and length-scale. A complete friction factor diagram covering the different turbulent flow regimes is presented and is favourably supported by laboratory experiments. For the first time, a theoretical calculation for the ratio between the wave friction factor and the wave energy loss factor is given. The uni-directional wave-current motion is briefly discussed. A novel study on the influence of a sloping wall on the turbulent wave boundary layer is presented. Unfortunately, no experimental data were available for comparison. Such a study is important for the calculation of flow around structures, since it has a combination of two pressure gradients due to the diffuser effect and the oscillatory motion, respectively. 117 refs.

4240 Pollution Control Equipment

51944 **(AFME—83-2335-2) Study of the catalytic incineration of the textile stenter gaseous effluents.** Lavoignet, D. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 240p. (In French). NTIS (US Sales Only), PC A11/MF A01; GPO Dep. Order Number DE88754038/JAW.

Textile finishing is one of the most energy consuming and polluting part of the textile industry. Heat exchangers have been used to recover waste heat but fouling and deposits in the pipes have a redhibitory effect. In this study, the catalytic incineration of the gaseous waste products is examined, in order to purify the air and recover energy. The catalytic incineration is realized at low temperature and with low price catalysts (Automobile industry catalysts).

4250 Power Cycles

REFER ALSO TO CITATION(S) 51504

43 PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 52364, 52365, 52366, 52367, 52368, 52369, 52745

51945 (CONF-760202—, pp 475-479) **Sandia Laboratories' proposed electron beam fusion facility and related potential operational health physics problems.** Holley, W.L. (Sandia Labs., Albuquerque, NM (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The relativistic electron beam fusion accelerator is capable of delivering up to 5 x 10^6 joules in a single 4 x 10^{12} watt peak power pulse (which will provide a factor of 25 times more power

than any e-beam accelerator at a similar voltage now in existence) and will be used in the expanded electron beam research program directed at achieving significant thermonuclear yields by heating and compressing deutetium-tritium fuel. The direct radiation is mostly attenuated by the self-shielding design of the machine and the shield adequately stops all radiation, direct and sky shine. The operational health physics problems will include 1) induced reactions from 10^{14} 14 Mev neutrons in the machine components, shielding materials, and air; 2) the problems related to a possible tritium release in the loading of the target pellets; 3) electron beam exposure; and 4) unloading, and cleanup of the machine.

4301 Design, Development, And Operation

51946 **(CONF-870302—255) Linear induction acclerators for industrial applications.** Adler, R.J.; Bayless, J.R. (Pulse Sciences, Inc., Agoura Hills, CA (USA)). 1988. Contract AC03-85ER80238. 3p. NTIS, PC A02/MF A01. Order Number DE88016846/JAW.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In this paper, we will briefly discuss the principles of the induction accelerator and will describe our development program. The goals of our program are to improve system reliability and to reduce system cost. An accelerator presently under construction which embodies a number of industrial improvements will be described. Unique features are a low cost accelerator design, and an SCR switched, tubeless pulsed power system. 3 refs., 4 figs.

51947 **(DOE/ER/10527—T8) Research on cw electron accelerators using room-temperature rf structures: Annual report.** (National Bureau of Standards, Washington, DC (USA); Los Alamos National Lab., NM (USA)). 15 Aug 1986. Contract AT01-79ER10527. 68p. NTIS, PC A04; 3; GPO Dep. Order Number DE88014784/JAW.

This joint NBS-Los Alamos project of "Research on CW Electron Accelerators Using Room-Temperature RF Structures" began seven years ago with the goal of developing a technology base for cw electron accelerators. In this report we describe our progress during FY 1986 and present our plans for completion of the project. First, however, it is appropriate to review the past contributions of the project, describe its status, and indicate its future benefits.

51948 (KURRI-TR—291, pp 66-70) **Acceleration of radioactive isotope beam.** Shinozuka, Tsutomu. (Tohoku Univ., Sendai (Japan). Cyclotron and Radioisotope Center). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

A research program has been developed which is aimed at investigating nuclei by varried probes. Accelerators used for this purpose should serve as secondary beam production facilities. The present report is focused on the combined use of a 1 Ge proton linac and H. I. linac to produce unstable nuclear beams. The ultimate objective of this system is to accelerate all nuclei that can exist in a many-body system. There are two methods that may serve to produce such unstable nuclear beams: 1) to use primary heavy ion beams to permit nucleus scission reaction, carry out mass separation of reaction products, and send specific beams to the next channel and 2) to use large-current high-energy proton beams to permit nuclear fracture reaction, carry out thermalization, re-ionization and mass separation of reaction products, and send them to the next channel. CERN ISOLDE can provide high-quality high-intensity RI beams. TRIUMF uses the combination of high-energy large-current protons, ISOL and heavy ion linac to produce high-quality large-current RI beams. Some features of CERN ISOLDE and TRIUMF are outlined. The currently planned system is equipped with a heavy ion accelerator up to 10 MeV-amu and expected to serve for discovery of unknown nuclides, nuclear spectrometric research, studies on low-energy unstable nuclear reactions, etc. (Nogami, K.).

51949 (KURRI-TR—293, pp 71-75) **Maintenance of KURRI-LINAC in 20 years.** Takami, Kiyoshi; Kimura, Yasuhiro; Yamamoto, Shuji; Kozuka, Toshihiko; Nishimoto, Kazuo; Kobayashi, Katsuhei; Fujita, Yoshiaki; Shibata, Toshikazu. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780146/JAW. (CONF-8608229—).

From 7. symposium on the development of advanced technology for scientific research; Kumatori, Japan (19 Aug 1986).

KURRI-LINAC (electron linear accelerator of the Research Reactor Institute, Kyoto University) is a facility for joint use program among universities and research institutes. It was constructed in 1965. Since 1966, this facility has been used by KURRI researchers, and many joint research programs have been started in 1968. In the present report the outline of the maintenance experience of KURRI-LINAC in 20 years are described.

51950 **(UCRL—97850) Engineering aspects and initial performance of ETA-II.** Prono, D.S.; Barrett, D.; Birx, D.L.; Boyd, J.K.; Caporaso, G.J.; Clark, J.C.; Coffield, C.F.; Deadrick, F.; Klingmann, J.; Nexsen, W. Jr.; Newton, M.A.; Ravenscroft, D.; Reginato, L.L.; Turner, W.C.; Westenskow, G.A.; Whitham, K. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 7p. (CONF-880713—16). NTIS, PC A02/MF A01. Order Number DE88016284/JAW.

From 7. international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

The Experimental Test Accelerator-II (ETA-II) is a high-average-power induction accelerator constructed at the Lawrence Livermore National Laboratory. Advanced engineering/accelerator technologies are required to achieve the ETA-II design parameters fo 7 MeV, 3 kA, 50 ns pulses with a 5 kHz repetition-rate capability for 30 s duration. We will summarize the engineering aspects of the ETA-II facility and its unique technologies and will report initial ETA-II facility operational data. 5 refs., 5 figs.

51951 **Supercollider: Assault on the summit.** Lederman, L. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *AIP (American Institute of Physics) Conference Proceedings;* **169**: No. 1, 170-184(20 Sep 1988). (CONF-8710320—).

From Modern physics in America: a Michelson-Morley centennial symposium; Cleveland, OH, USA (30 Oct 1987).

Design and cost of the Superconducting Super Collider are discussed as well as the fundamental studies for which it is proposed./aip/.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 51947, 52562, 52563, 52732

51952 **(DOE/ER/10666—1) Transfer map methods for computing particle beam transport in linear and nonlinear elements: Progress report.** Dragt, A.J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). May 1981. Contract AS05-80ER10666. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016265/JAW.

During the past nine months, considerable progess has been made in developing the method of transfer maps. Methods have been devised for computing transfer maps for all standard beam elements including drifts, dipoles, quadrupoles, solenoids, sextupoles, octupoles, bunchers, and accelerating cavities.

51953 **(DOE/ER/40150—48) The loss parameters for very short bunches.** Bisognano, J.J.; Heifets, S.A.; Yunn, B.C. (Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility). 1987. Contract AC05-84ER40150. 22p. (CEBAF-PR—88-005). NTIS, PC A03/MF A01. Order Number DE88015976/JAW.

Semi-empirical formulas for the transverse and longitudinal loss factors generated by cavity and step discontinuities are given in the limit of short bunch length. The parametric transition between the cavity and step approximations is considered. The differences between the impedances offered by periodic structures and isolated single cavities are also discussed. 13 refs., 6 figs.

51954 **(DOE/ER/40150—49) Comments on the high-frequency behavior of the coupling of an accelerator beam to its environment.** Bisognano, J.J. (Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility). 1988. Contract AC05-84ER40150. 16p. (CEBAF-PR—88-006). NTIS, PC A03/MF A01. Order Number DE88015975/JAW.

The short bunch lengths and the associated high frequencies found in the latest designs of linear colliders, superconducting linacs, FEL drivers, damping rings, and synchrotron light sources have heightened the importance of understanding the high-frequency behavior of the interaction of an accelerator beam with its environment. This parametric domain is at the limits of both the numerical and analytical tools which have been developed to date, and consequently there exists some question as to the correct asymptotic frequency dependence. The resulting uncertainty in the coupling of a particle beam to vacuum chamber discontinuities has hindered evaluation of bunch lengthening in storage rings and transverse beam blowup in linacs, and limits confidence in assessments of beam quality in proposed designs. Another high-frequency phenomenon, which is of particular concern in damping and storage rings, is the synchrotron radiation process in the presence of conductive boundaries. Estimates have indicated that this effect can provide the dominant limit on peak beam current in small, smooth-walled machines, but this earlier work does not take into account fully the complex, finite-Q resonance structure which is present. The charge to the August 1987 Impedance Beyond Cut-off Workshop at Lawrence Berkeley Laboratory was to investigate these issues in some depth and to provide clarification of the main features of the beam coupling impedance at frequencies well-above the lowest propagation frequency of the beam pipe. Subsequent papers in this volume present the detailed results of the workshop participants. In this note the motivation for this effort, an overview of the progress made, and a few remarks on remaining questions is offered. 13 refs.

51955 **(FNAL/C—88/101) Analytical and numerical evaluation of Landau cavities in the Fermilab Booster.** Chao, Yu-Chiu; Ng, King-Yuen. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Jun 1988. Contract AC02-76CH03000. 4p. (CONF-880695—55). NTIS, PC A02. Order Number DE88016245/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

Longitudinal coupled bunch instability has been observed in the Fermilab Booster at high intensity. It is a cause for concern due to its effect on the Tevatron collider performance. We study this phenomenon using initial value technique to correctly account for the underlying transient nature. Analytic result is obtained for any mode and comparison is made between ordinary harmonic potential and higher harmonic (Landau) cavity potential. A computer program is developed to facilitate the calculation. The result shows that the merit of Landau cavity is best realized in cases where the resonance is of a broad band nature. 5 refs., 4 figs., 3 tabs.

51956 (INIS-SU—37/A, pp 12-18) **Problems of microprobe ion optics.** Dymnikov, A.D. (Leningradskij Gosudarstvennyj Univ. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

Ion beams with the energy of several megaelectronvolt per a nucleon focused to a micron cross section become consequently a usual device in several acceleration laboratories of the world. They give the widest spectrum of nondestructive methods of qualitative microanalysis with low detection limits (of 10/sup -6/ order) for practically all chemical elements and a lot of isotopes. Two the most usable ion-optical flowsheets of a microprobe based on quadrupole lenses: doublet and quartet operating in the quadruplet rotation mode, are compared. Main ion-optical characteristics of the systems compared are calculated taking into account chromatic and geometric abberations; requirements to the focusing devices shaping micron and submicron beams are discussed. 2 refs.; 2 tabs.

51957 (INIS-SU—37/A, pp 19-28) **Nuclear microprobes and its application.** Bondarenko, V.N.; Goncharov, A.V.; Kolot, V.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

Ion-optical specifications of microprobes based on quadrupole multiplets, superconducting solenoids and the plasma lense are considered. Basic parameters of microprobes obtained by simple collimation and using microprobes with different focusing elements are presented. Methods for experimental results obtaining, acquisition and processing are described. Application of techniques of characteristic x radiation, nuclear reactions, ion backscattering and nucleus recoil with ion beams of micron sizes to investigate different objects is illustrated. 29 refs.; 5 figs.; 4 tabs.

51958 (INIS-SU—37/A, pp 77-81) **Complex calculation and improvement of beam shaping and accelerating system of the "Sokol" small-size electrostatic accelerator.** Simonenko, A.V.; Pistryak, V.M.; Zats, A.V.; Levchenko, Yu.Z.; Kuz'menko, V.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

Features of charged particle accelerated beam shaping in the electrostatic part of the "Sokol" small-size accelerator are considered in complex taking into account the electrode real geometry. Effect of the extracting, accelerating electorde potential and accelerator total voltage on beam behaviour is investigated. A modified variation of the beam shaping system, allowing to decrease 2 times the required interval of accelerating electrode potential adjustment and to decrease the beam size in the starting acceleration region, is presented. It permits to simplify the construction and to improve accelerator operation. Comparison of experimental and calculational data on the beam in the improved accelerator variation is carried out. Effect of peripheral parts of accelerating tube electrodes on the beam is investigated. 4 refs.; 5 figs.

51959 (INIS-SU—51, pp 35-37) **To the nonlinear theory of diocotron instability.** Ignatov, A.M.; Filippychev, D.S. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

The interaction of oscillations of a hallow electron beam is studied. It is shown that decay processes bring about the formation of stationary states with beam cross section as a deformed ring. Diocotron instability arises when hollow beam (or plasma bunch) propagates along strong (for electrons the cyclotron frequency much higher than for plasma)external magnetic field. Under the effect of crossed fields - proper electric and external magnetic particle transverse drift occurs. Due to inhomogeneity of electric field the velocity shear arises which is the source of nonequilibrium state. 2 refs.; 2 figs.

51960 **(LBL—25370) The renormalized theory of beam-beam interaction.** Chin, Yong Ho. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 4p. (CONF-880695—59). NTIS, PC A02/MF A01. Order Number DE88016628/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

A new approach to calculate analytically the particle distribution in the presence of beam-beam interaction and synchrotron radiation effects for an electron-positron colliding beam storage

ring is presented. The method is based on correct calculation of the Green's function which includes the full effect of the beam-beam force on the distortion of particle orbits, borrowing the renormalization technique of quantum field therory. By this way, the theory is applicable to any level of beam-beam interaction, no matter whether chaos ensues in phase space or not. This paper is devoted mostly to verificaiton of the theory by comparison with the results of computer simulations. Fairly good agreements are obtained. 5 refs., 3 figs.

51961 **Relativistic focusing and beat wave phase velocity control in the plasma beat wave accelerator.** Esarey, E.; Ting, A.; Sprangle, P. (Plasma Theory Branch, Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375-5000). *Applied Physics Letters;* **53**: No. 14, 1266-1268(3 Oct 1988).

Relativistic focusing allows two collinear short pulse radiation beams, provided they are of sufficiently high power, to propagate through a plasma without diffracting. By further accounting for finite radial beam geometry, it is possible for the phase velocity of the radiation beat (ponderomotive) wave to equal to the speed of light. This removes one of the limiting factors, phase detuning between the accelerated electrons and the beat wave, in determining the maximum energy gain in the plasma beat wave accelerator.

51962 **Gigatron.** (Dept. of Physics, Texas A and M Univ., College Station, TX (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 258-263(Apr 1988).

The gigatron is a new RF amplifier tube designed for linac collider applications. Three design features permit extension of the lasertron concept to very high frequencies. First, a ribbon-beam geometry mitigates space-charge depression and facilitates efficient output coupling. Second, a traveling-wave output coupler is used to obtain optimum coupling to the ribbon beam. Third, a grated field-emitter array is employed for the modulated cathode. A prototype device is currently being developed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 51863, 51890, 52615

51963 **(CNIC—00107) Argon duoplasmatron ion source.** Yu Lihua; Wang Chaoju; Guan Shouren; Sun Shuhua; Xu Guoji; Luo Xinghua. (Academia Sinica, Beijing (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). 1987. 7p. (In Chinese). (IAE—0032). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704100/JAW.

A duoplasmatron ion source has been developed for making targets by its focused heavy ion beam sputtering. The argon ion beam of 1 ~ 2 mA can be produced and accelerated to a maximum energy of 10 keV. By adjusting the focusing effect of the einzel lens and discharge conditions of the ion source, the diameter of the ion beam spot on the traget is minimized to about 2 mm (the full width at 1/10 maximum of beam density distribution) and 1 mm (FWHM). Continual operation time exceeds 24 hours.

51964 **(DOE/ER/40150—47) A continuous injector-ejector scheme for damping rings.** Kewisch, J.; Rossmanith, R. (Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility). 1987. Contract AC05-84ER40150. 5p. (CEBAF-PR—88-008; CONF-871299—3). NTIS, PC A02/MF A01. Order Number TI88015848/JAW.

From Workshop on heavy quarks factory and nuclear physics facility with superconducting linacs; Courmayeur, Italy (14 Dec 1987).

In this paper we describe a new injection-ejection scheme for damping rings, in which several bunches are simultaneously stored and cooled. The application of kickers becomes difficult when the injection and ejection frequency exceeds several hundred Hz. It is proposed to use several cavities in a deflecting mode at different frequencies in order to select a single pulse out of the stored pulse train. 4 refs., 3 figs., 1 tab.

51965 **(HH-IEP—88-01) Polarization of antiprotons by the Stern-Gerlach effect.** Kewisch, J.; Rossmanith, R.; Onel, Y.; Penzo, A.; Kreiser, H. (CEBAF, Newport News, VA (USA); Geneva Univ. (Switzerland); Texas Univ., Austin (USA); European Organization for Nuclear Research, Geneva (Switzerland); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). (Hamburg Univ. (Germany, F.R.). 1. Inst. fuer Experimentalphysik; Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility; Geneva Univ. (Switzerland); Texas Univ., Austin (USA); European Organization for Nuclear Research, Geneva (Switzerland); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). Jan 1988. 8p. (CONF-8709160—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754313/JAW.

From 4. LEAR workshop; Villars-sur-Ollon, Switzerland (6 Sep 1987).

A method to obtain polarized antiprotons in the low energy storage ring LEAR via spatial separation of opposite spin states is described in earlier papers (Y. Onel et al., 1986). We will discuss here in more detail a) the integration of the special magnets (spin splitter) into the LEAR optics and b) some first tracking results of particle and spin motion in these optics. (orig./HSI).

51966 **(JINR—13-87-613) Transmission device for controlling heavy ion beam shape.** Luk'yanov, S.M.; Heidel, K.; Chubaryan, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions; Erevanskij Fizicheskij Inst. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703333/JAW.

Submitted to the journal Nucl. Instrum. Meth.

A special device is presented which enables one to observe the beam shape with unsignificant distortions of the beam parameters. The operation principle of the present device is based on the secondary electron emission phenomenon from a thin surface layers after irradiation of them by charged particles. Microchannel plates are used for the electron multiplications. The results of testing this device in a heavy ion beam are given. 6 refs.; 2 figs.

51967 (KURRI-TR—293, pp 15-21) **Improvement of the vacuum system of the Tohoku 4.5-MV dynamitron.** Sakamoto, Ryuji. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Sep 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780146/JAW. (CONF-8608229—).

From 7. symposium on the development of advanced technology for scientific research; Kumatori, Japan (19 Aug 1986).

The vacuum system of the Dynamitron accelerator at Tohoku University has been improved by replacing the oil diffusion pumping systems for the main and sub-stations with the turbo molecular ones. Performance of the upgraded system is described.

51968 **Experimental confirmation of the reditron concept.** Davis, H.A.; Bartsch. (Los Alamos National Lab., Los Alamos, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 192-198(Apr 1988).

The authors describe experiments that demonstrate a new method for producing high-power microwave emission. The unstable oscillations of a virtual cathode, which forms when a magnetized relativistic electron beam is injected into a circular waveguide, generate the microwave radiation. In contrast to previous virtual-cathode microwave-generation techniques, electrons in the waveguide are prevented from reflexing back into the diode region by use of a slotted range-thick anode. Electrons injected into the waveguide are guided through the slot by an applied magnetic field, while reflected electrons, under the proper conditions, are intercepted by the anode. Several advantages of this approach are described, and experimental confirmation of this mode of high-power microwave generation is demonstrated. Also, data showing frequency scaling with beam parameters and magnetic field are presented. Using this technique, the authors produced 1.4 GW at 3.9 GHz with several hundred megawatts radiated in harmonic radiation.

51969 **Operation of a large-orbit high-harmonic multicavity gyroklystron amplifier.** Furuno, D.S.; McDermott, D.B.; Luhmann, N.C. Jr.; Vitello, P.; Ko, K. (TRW, Inc., Redondo Beach, CA (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 2, 155-161(Apr 1988).

The high-harmonic gyroklystron is a moderate-power millimeter-wave amplifier which is based on the interaction of a large-orbit axis-encircling electron beam with high-order TE/sub n11/ cylindrical cavity modes. The required high-energy electron beam is produced by fundamental mode gyroresonant acceleration. The use of the high-harmonic interaction together with RF acceleration makes for a compact, lightweight amplifier which avoids the high magnetic fields and high dc voltages of the conventional gyroklystron. The latest version of the authors' experimental device is a four-cavity fifth-harmonic amplifier operating at 11.3 GHz in a 1.2-kG magnetic field. This device uses longer drift regions than our previous configurations. Principal results include 45 dB of small-signal gain and 0.6 kW of output power. Other results include the measurement of phase noise characteristics and the identification of spurious output signals. An improved beam diagnostic which determines the pitch of the electron orbits has been used together with a fluorescent uranium glass witness plate and beam current diagnostics to characterize the electron beam. This information was used to perform analytic modeling and computer simulation of the amplifier. The experimental results are compared with the predictions of the analytic theory and simulation, and substantial agreement is demonstrated.

4304 Storage Rings

51970 **(BNL—41554) Lifetime and performance of NSLS storage rings.** Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880552—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015716/JAW.

From Topical conference on vacuum design of advanced and compact synchrotron light sources; Upton, NY, USA (16 May 1988).

The performance of synchrotron light sources is measured primarily in terms of beam lifetime, beam size, and the recovery of normal operation after a section of the machine has been brought to atmospheric pressure. The beam lifetime and the beam size depend on the following phenomena: Beam gas interaction which can be either elastic or inelastic scattering on residual gas nuclei or electrons. With the exception of low energy machines, this phenomenon represents the main limiting factor on lifetime; Beam interaction with trapped ions causing both beam loss and defocussing. Residual gas molecules are ionized both by circulating beam and synchrotron radiation. The cross sections for both processes are comparable. The effects of this phenomenon are most troublesome at low energies. The problem can be eliminated by switching to positron beams. Installing clearing electrodes has also been successful; Intrabeam scattering (Touschek effect) is caused by Coulomb scattering among electrons of the same bunch as they execute betatron oscillations. The Touschek effect is strongly dependent on energy and in general is a problem only in low energy machines; and Various instabilities causing both slow and fast beam decay which have been observed in both NSLS rings. A special case due to dust particles that fall into the electron beam is commonly observed in early stages of conditioning. Coherent collective instabilities will not be discussed in this paper. 19 refs., 4 figs., 1 tab.

51971 (INIS-SU—51, pp 19-21) **Neutrino beams of the UNK collider.** Zotov, N.P.; Tsarev, V.A. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

A principled possibility of performing neutrino experiments at the UNK operating at the collider regime is shown. The neutrino flux estimates and the number of events in the detector for direct neutrinos are shown. The estimates given show that there is a principled possibility for neutrino experiments at the UNK-collider with the reasonable statistics about 10/sup 5/ events/year at energies inaccessible at existing accelerators with stationary targets. 2 refs.; 2 tabs.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 50731, 50879, 51839, 51841, 51966, 52226, 52261, 52262, 52263, 52264, 52274, 52299, 52357, 52371, 52378, 52427, 52475, 52532, 52549, 52723, 52787

51972 **(BARC—1394) Development of CAMAC and Fast-bus instrumentation.** Venkateswaran, Aruna; Behere, Anita; Ghodgaonkar, M.D.; Bairi, B.R. (Bhabha Atomic Research Centre, Bombay (India). Electronics Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704084/JAW.

This report describes the work being done towards the development of CAMAC and Fast Bus Instrumentation under the VII Five Year Plan Project 'Modernisation of Reactor Control Instrumentation and Development of CAMAC and FAST BUS Instrumentation'. The report summarises the goals, objectives, principles and concepts of CAMAC and Fast Bus Instrumentation. While emphasizing the motivation behind the development of CAMAC and Fast Bus Instrumentation, the report brings out the current status and future plans of this development program.

51973 (BNL—39428, pp P16) **Instrument for in vivo determination of bone mineral concentration by coherent-compton scattering.** Nilsson, U.; Ahlgren, L.; Mattsson, S. (Lund Univ., Goteborg (Sweden)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

An instrument to measure the bone mineral concentration in the human vertebrae using the ratio of coherent to compton scattered 60 keV photons will be described. Two 11 GBq ^{241}Am sources are used and the scattered radiation (145°) is measured by means of Ge-spectrometer. To convert the measured ratio of coherent/compton scattered photons to bone mineral concentration the authors have used vertebrae like phantoms placed in water. The phantoms contained various amounts of $CaHPO_4$ in epoxy. The influence on the measurements of different positions of the vertebrae has been studied as well as the variation in sensitivity inside the vertebrae.

51974 (CONF-760202—, pp 440-444) **Low-range dosimeter for radiation protection surveys in diagnostic radiology.** Syed, I.B.; Hanc, R.P.; Maddux, F. (Wesson Memorial Hospital, Springfield, MA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

For checking the adequacy of primary and secondary protective barriers and in measuring leakage radiation from the protective tube housing, the STRAD is a desirable dosimeter in the field of Diagnostic Radiology. Calibration of this instrument poses a big problem because it is highly sensitive with a full-scale range of only 1 milliroentgen. The full-scale has 50 divisions, permitting readings as low as 0.02 milliroentgen with a single exposure. Therefore, calibration of this dosimeter, using useful beam, is impracticable. Hence scattered radiation was utilized to calibrate this instrument for which it is specifically designed. Two methods of calibration are presented; one utilizing the inverse square law and the other utilizing the variation in exposure techniques.

51975 (CONF-760202—, pp 578-581) **Detection of internally deposited actinides part IV: preliminary considerations in the use of large, planar intrinsic GE detectors.** Bemis, C.E. Jr.; Goans, R.E.; Good, W.M.; Warner, G.G. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Many inherent advantages are apparent in the user of large planar Ge detectors for the detection, identification and quantitative assessment of internally deposited actinide nuclides. The superior energy resolution in contrast to Phoswich type scintillation detectors, permits isotopic identifications to be made and reduces ambiguities introduced by natural and human background effects. The authors preliminary studies indicate that 10 cm^2 x 1.2 cm Ge detector is comparable in detection sensitivity to that of one 125 cm^3 Phoswich detector. Some preliminary considerations and evaluations, photon transport studies based on Monte Carlo modeling and measurements of absolute L-series X-ray yields in the decay of several actinide nuclides, are presented.

51976 (CONF-760202—, pp 627-631) **Portable gamma bioassay system.** Zubal, I.G.; Dare, J.G.; Gillespie, B.M.; Deutchman, A.H.; Nowels, G.C. (Ohio State Univ. Hospitals, Columbus (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A portable, inexpensive gamma bioassay system has been developed that is sensitive enough to accurately measure body burdens in the nanoCurie range. A single channel pulse height analyzer scaler with a 1" x 1" NaI(T1) detector was calibrated with a clinical thyroid counting system using an ORINS neck phantom. Count rate versus activity curves were established for Iodine-125, Iodine-131, and Technetium-99m. Experiences with the gamma bioassay system, including set-up problems and system advantages, will be discussed.

51977 (CONF-760202—, pp 635-638) **Radiation Monitoring Systems in a changing regulatory environment.** Iacovino, J.M. Jr. (Nuclear Energy Systems, Pittsburgh, PA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The Radiation Monitoring System (RMS) in a nuclear power plant is used for assessing radiological impact of plant operation, for satisfying regulatory commitments, and in meeting society's demand for responsible plant operation. The extent to which various regulatory requirements have or will influence the design of Radiation Monitoring Systems is discussed here. An RMS consists of several types of radiation detectors strategically placed about a nuclear plant to insure the safety of operating personnel and the surrounding environment. It serves in conjunction with, and as backup to, a comprehensive sampling program to quantitatively evaluate process systems and effluent activity levels. The cost and radiation range of detectors commonly employed in an RMS are presented. At the low end of the cost spectrum are G-M counters and pressurized ion chambers. These are used to monitor airborne activity in inhabited spaces outside the containment. Areas surveyed include the control room, radiochemistry laboratory, spent fuel pool, and waste drumming station. The number of area monitors used in a plant (normally between fifteen and thirty) and their placement depend on the reactor type and the plant layout. Pressurized ion chambers have been extensively applied in environmental monitoring on the general plant site.

51978 (CONF-760202—, pp 112-115) **Scintillation flasks for the determination of low level concentrations of radon.** George, A.C. (Energy Research and Development Administration, New York, NY (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Simple, inexpensive scintillation flasks that are easier to maintain and are more sensitive than flasks of conventional design have been fabricated for measuring environmental radon. The flasks which are of two sizes (3 in. and 4 1/2 in. diameter), are constructed of plastic tubing and sheet, fitted with brass valves for flow-through sample collection, and are coated internally with silver-activated zinc sulfide phosphor. When counting background becomes excessive through use, the flasks can be easily cleaned and rephosphorbed. The sensitivities of the small and large radon flasks for 1 pCi/l of ^{222}Rn are about 0.7 cpm and 2 cpm, respectively, when counted after the daughters have grown into equilibrium with the radon, compared to about 0.5 cpm for standard Lucas flasks.

51979 **(DOE/ER/40367—T1) Radiation damage study for silicon calorimetry: Summary of first year's activity.** Russ, J.S. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). [1988]. Contract AC02-87ER40367. 28p. NTIS, PC A03/MF A01. Order Number DE88016546/JAW.

In the first contract year of this activity at Carnegie-Mellon we have had two major objectives. These were to devise and test a non-intrusive means to measure the energy and spatial profiles of the neutrons generated in a hadronic cascade at high energy; and to study the calibration systematics of silicon diode detectors as a prelude to their evaluation for SSC calorimetry. These objectives have been carried out, as are described in this paper. In addition we have recoded the ORNL detector simulation program HETC to operate on a VAX and are working on the conversion of the low energy neutron transport program MORSE. These programs are used heavily at Oak Ridge (Gabriel and coworkers) for cascade studies. For silicon calorimetry one wants to have more control over the energy deposition routines, especially in MORSE. Unfortunately, MORSE is heavily-laden with machine code, and its conversion is going slowly. 11 refs., 5 figs.

51980 **(DOE/NE/37959—18) Signal anomaly detection and characterization.** Morgenstern, V.M.; Upadhyaya, B.R.; Gloeckler, O. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). Aug 1988. Contract AC02-86NE37959. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015701/JAW.

As part of a comprehensive signal validation system, we have developed a signal anomaly detector, without specifically establishing the cause of the anomaly. A signal recorded from process instrumentation is said to have an anomaly, if during steady-state operation, the deviation in the level of the signal, its root-mean-square (RMS) value, or its statistical distribution changes by a preset value. This deviation could be an unacceptable increase or a decrease in the quantity being monitored. An anomaly in a signal may be characterized by wideband or single-frequency noise, bias error, pulse-type error, nonsymmetric behavior, or a change in the signal bandwidth. Various signatures can be easily computed from data samples and compared against specified threshold values. We want to point out that in real processes, pulses can appear with different time widths, and at different rates of change of the signal. Thus, in characterizing an anomaly as a pulse-type, the fastest pulse width is constrained by the signal sampling interval. For example, if a signal is sampled at 100 Hz, we will not be able to detect pulses occurring at kHz rates. Discussion with utility and Combustion Engineering personnel indicated that it is not practical to detect pulses having a narrow time width. 9 refs., 11 figs., 8 tabs.

51981 **(GSI—88-06) Photodiode read-out of CsI (Tl) scintillators.** Kreutz, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.)). Mar 1988. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754833/JAW.

The photodiode read-out of CsI(Tl) scintillator detectors up to a size of 100 cm/sup 3/ was examined and developed further. In preparatory measurements with a combination of small crystals ($\approx$ 3 cm/sup 3/) and photodiodes with active surfaces of 1 cm/sup 2/, γ spectra could be recorded, whose energy resolution (4.4% at 1.3 MeV) is not exceeded by any other scintillation detector. In order to improve the resolution when using CsI(Tl) crystals with a volume greater than 30 cm/sup 3/, wavelength correctors were produced and tested. This target was not reached with the crystal dimensions used. Based on these measurements, one suspects that with even larger scintillators, one can expect an improvement of energy resolution compared to the direct read-out. It was also shown that it is possible, even at low energies ($<$ 10 MeV) to identify γ radiation, neutrons and charged particles (p, d, t, α) by analysis of the time course of the photodiode signal.

51982 **(GSI—88-15-Prepr.) Detection of high-energy photons and fast neutrons with BaF/sub 2/ scintillators.** Matulewicz, T. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Feb 1988. 15p. (CONF-880195—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754311/JAW.

From 26. international winter meeting on nuclear physics; Bormio, Italy (25 Jan 1988).

Extensive Monte-Carlo calculations using the code GEANT3 have been performed for the design of a spectrometer for photons (π/sup 0/,eta) at GSI Darmstadt. Simulations of the photon-induced electromagnetic shower in BaF/sub 2/ showed, that for photon energies below 100 MeV a detector of 20 cm length is sufficient, while at higher energies the detector length has to increase to 25 cm to provide the necessary efficiency and energy resolution. Calculated lineshapes compare very well with experimental data obtained at a photon energy of 50 MeV. Properties of BaF/sub 2/ as a detector of neutrons with kinetic energies below 22 MeV were studied. The detection efficiency strongly depends on the light-output threshold, since the detector response is of exponential shape. The pulse shape analysis used to distinguish photons from charged particles does not allow to separate photons from neutrons at energies below 22 MeV. However, at neutron energies above 11 MeV we observe the appearance of a detection mechanism involving charged particles in the exit channel.

51983 **(INIS-BR—1236) New electret dosemeter for radiotherapy.** Rodrigues, L.N. (Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica). 1985. 130p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704123/JAW.

The results obtained with a new plane electret dosemeter for use in Radiotherapy are presented. The working principle of the electret dosemeter in based on the use of the electret field the ion collecting field, similarly to an ionization chamber, and as charge integrator detector. The dosemeter had, initialy, a cylindrical geometry. The results attained with it's calibration curve concerning the sensitivity, the stability and the reproducibility lead to changes in the dosemeter geometry. A plane geometry dosemeter was built in order to increase the useful exposure range. The plane dosemeter sensitivity dependence was measured versus the electret charging conditions, the chamber volume and wall material (aluminium, brass and stainless steel). The stainless steel dosemeter showed the best results. This dosemeter has the following characteristics: sensitivity 10/sup -13/C/R, volume 0.20 cm/sup 3/. Compared to the Baldwin-Farmer dosemeter, this results are fairly good. A multiple electret dosemeter was developed to monitor the uniformity of the radiation beam for a Cobalt Teletherapy unit. The intercomparasion with the Baldwin-Farmer unit presented a maximum variation of 3%.

51984 (INIS-mf—11261, pp 139-142) **Measuring system for global beta-activity in the environment.** Vojkulesku, G.; Nikolesku, Dm.; Matake, M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A beta-activity detector has been developed for measuring low levels of beta-activity of the samples from NPP environment, with providing low background. A reference 0.52 Bq source has been measured with 20% relative error within 2 hours. The detector has a high sensitivity, good discrimination with respect to beta/gamma-activity and can be employed for inspection of samples with large surface area. The minimal detectable energy is 150 keV, the window apperture is 100 sm/sup 2/. The efficiency of beta-activity detection is better than 10% for C-14, 35% for Tl-204 and 40% for Sr-90 + Y-90.

51985 (INIS-mf—11261, pp 143-150) **Thermoluminiscent dosemeter for NPP environment inspection.** Lazehr, E.; Nikolae, M. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Design and performance of a thermoluminiscent dosemeter for radiation level inspection in the NPP environment are described. The dosemeter employs detectors based on CaF-2-Mn and can measure the integral photone dose within (10/sup -2/ -1) Gyr-ange. Such dosemeters will be placed at the NPP site and within the inspected surrounding region. The dosemeter can be used in the environment during 30 days and longer since its detection threshold is within 5.16x10/sup 4/ -7.74x10/sup -4/ mC/kg (2.2 mR) range, while the information regression does not exceed 10% within 40 days. 2 tabs.; 4 figs.

51986 (INIS-mf—11261, pp 177-185) **Measuring of low radionuclide concentrations in an underground laboratory protected against cosmic rays.** Tsvetkov, O.S.; Triumfov, N.G. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The results of comparative measurings of gamma-, beta- and neutron detector background characteristics are presented that were obtained in on- and underground low-background laboratories. the rassive shielding of the underground laboratories has been shown to provide a considerably lower background of radiometric instrumentation as compared with that in the on-ground one. The radiation background in the underground laboratories has also been found to remain constant since the contribution from the cosmic rays is to a great extent suppressed by a ground layer of 120 m water equivalent. This fact allows to double the radiometric instrumentation sensitivity and increase the measurement productivity by factor of 4. 5 refs.; 2 tabs.; 5 figs.

51987 (INIS-mf—11261, pp 160-176) **Ge(Li) spectrometer with low background under various shielding conditions.** Shekherov, L.J.; Prodanov, Ya.; Stefanov, G.I.; Golovlev, V.G.; Triumfov, N.G.; Flegontov, V.M.; Tsvetkov, O.S. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Gamma-ray background conditions have been investigated for low-background detector chambers and working premises. Measuring were carried out with 4 chamber types in one onand two underground laboratories at various geographical latitudes and elevations 4 types of passive shielding and 3 design options have been studied. The chamber quality and abilities are compared. Data have been obtained on the chamber and working premises natural background, independent of the detector system. The counting rates for different intervals of gamma-ray background are presented as well as the calculated quality coefficients, total and selective attenuation ratios. 8 refs.; 7 tabs.; 3 figs.

51988 **(INIS-mf—11309) 9th European experimental NMR conference.** (Graz Univ. (Austria)). 1988. 199p. (CONF-8805190—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW.

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

30 oral contributions and 105 posters are presented by abstracts or short communications. The subject matter are various aspects of the experimental technique and various applications of NMR. (qui).

51989 (INIS-mf—11309, pp 171) **Cross-polarization for quadrupolar nuclei: proton to Sodium-23.** Harris, R.K.; Nesbitt, G.J. (Durham Univ. (UK)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51990 (INIS-mf—11309, pp 160) **Steady-state inversion recovery technique for slowly relaxing nuclei in liquids.** Kreibich, W.; Schwenk, A. (Tuebingen Univ. (Germany, F.R.). Physikalisches Inst.). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51991 (INIS-mf—11309, pp 139) **First high-pressure, high-resolution NMR probe working at 400MHz.** Frey, U.; Helm, L.; Merbach, A.E. (Lausanne Univ. (Switzerland)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51992 (INIS-mf—11309, pp 132) **Image processing techniques applied to 2D NMR spectroscopy.** Sole, P.; Levy, G.C.; Delaglio, F. (Syracuse Univ., NY (USA); New Methods Research, INC., Syracuse, New York (USA)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51993 (INIS-mf—11309, pp 130-131) **Imaging of a rotating object.** Matsui, S.; Sekihara, K.; Shiono, H.; Kohno, H. (Hitachi Ltd., Kokubunji, Tokyo (Japan). Central Research Lab.). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51994 (INIS-mf—11309, pp 124-125) **High frequency E.C. (equal current) 'whole rat' coil using transmission line elements.** Bergman, A.H.; Vaals, J.J. van; Boef, J.H. den. (Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands). Forschungslaboratorium). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51995 (INIS-mf—11309, pp 123) **Solid state NMR imaging using 'solid echos'.** Attard, J.J.; Mcdonald, P.J. (Surrey Univ., Guildford (UK). Dept. of Physics). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51996 (INIS-mf—11309, pp 121-122) **High resolution heteronuclear spectroscopy in inhomogeneous magnetic fields.** Duce, S.L.; Hall, L.D.; Norwood, T.J. (Cambridge Univ. (UK); Addenbrooke's Hospital, Cambridge (UK)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51997 (INIS-mf—11309, pp 117) **Two-dimensional /sup 13/C-MAS-NMR.** Yang, Y.; Schuster, M.; Hagemeyer, A.; Bluemich, B.; Spiess, H.W. (Max-Planck-Institut fuer Polymerforschung, Mainz (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51998 (INIS-mf—11309, pp 111) **Linear prediction. Spectral transformation using a recursive technique (STUART).** Stephenson, D.S. (Universitaet Muenchen, Institut fuer Organische Chemie, Muenchen (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

51999 (INIS-mf—11309, pp 110) **Linear prediction. Application to high resolution solid state NMR spectroscopy.** Stephenson, D.S.; Sebald, A. (Universitaet Muenchen, Institut fuer Organische Chemie, Muenchen (Germany, F.R.); Bayreuth Univ. (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52000 (INIS-mf—11309, pp 93) **Design of an efficient probe for cross-polarization variable-angle spinning NMR of solids.** Daugaard, P.; Langer, V.; Jakobsen, H.J. (Aarhus Univ. (Denmark)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52001 (INIS-mf—11309, pp 69) **Linear prediction applied to the analysis of NMR-data from p21 kinetics measurements.** Ruff, H.; Schlichting, I.; Roesch, P. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52002 (INIS-mf—11309, pp 68) **Application of M.E.M. to the study of a ten base-pair D.N.A. fragment.** Delsuc, M.A.; Stoven, V.; Guittet, E.; Lallemand, J.Y. (Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52003 (INIS-mf—11309, pp 67) **'A.T.P.' - a program for real time processing and analysis of the NMR signal.** Piveteau, D.; Gillet, B.; Lallemand, J.Y.; Beloeil, J.C.; Morellet, N.; Champagnat, J.; Fortin, G. (Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52004 (INIS-mf—11309, pp 63-64) **Symbolic algebra: a useful tool for NMR?.** Khuen, A.; Forster, P. (Technische Univ. Berlin (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52005 (INIS-mf—11309, pp 62) **Suppression of the lineshapes and baseline distortions arising in the NMR spectra from the first-order phase correction.** Starcuk, Z.; Halamek, J.; Starcuk, Z. Jr. (Institute of Scientific Instruments of the Czechoslovak Academy of Sciences, Brno (Czechoslovakia)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52006 (INIS-mf—11309, pp 61) **E.COSY experiment without 'small-angle' phase shifts.** Praestholm, P.; Bildsoee, H.; Madsen, J.C. (Aarhus Univ. (Denmark)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52007 (INIS-mf—11309, pp 60) **Indirect, negative NOE on the homonuclear two-dimensional spectrum.** Pelczer, I.; Rozsa, Z. (Inst. for Drug Research, Budapest (Hungary); 'A. Szent-Gyoergyi' Medical University, Szeged (Hungary)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52008 (INIS-mf—11309, pp 59) **Generalization of construction of correlation space (CCS).** Pelczer, I.; Szalma, S.; Dombi, G. (Inst. for Drug Research, Budapest (Hungary); Institute of Pharmaceutical Chemistry, Albert Szent-Gyoergyi Medical University, Szeged (Hungary)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52009 (INIS-mf—11309, pp 57-58) **2D NMR relaxation spectroscopy: theory and applications.** Mueller, K.; Schleicher, A.; Kothe, G. (Stuttgart Univ. (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52010 (INIS-mf—11309, pp 56) **Compression of 2D NMR spectra.** Zolnai, Z.; Macura, S.; Markley, J.L. (Belgrade Univ. (Yugoslavia); Wisconsin Univ., Madison (USA). Dept. of Biochemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52011 (INIS-mf—11309, pp 52-53) **Simple rf phase cycling scheme.** Higinbotham, J.; Allan, D.D.M.; Malcolm, I.C. (Napier College, Department of Physics, Edinburgh (UK)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52012 **(INIS-mf—11759) HASYLAB annual report 1987.** (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Hamburger Synchrotronstrahlungslabor). 1988. 443p. (In German). NTIS (US Sales Only), PC A19/MF A01. Order Number DE88754322/JAW.

This annual report contains extended abstracts about the work performed at HASYLAB together with a list of publications, speeches, and theses. The work concerns technical developments, the study of the electronic structure of atoms, molecules, solids, surfaces, and liquids, X-ray structure studies of solids and interfaces, molecular biology, further applications of synchrotron radiation, and experimental developments. (HSI).

52013 **(JINR—R-10-87-193) Self-tracking of mass processing of experimental data on the ES computer.** Anikhovskij, V.E.; Govorun, N.N.; Evsina, V.N. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703412/JAW.

Submitted to the journal PTE.

Methods and software for effective organization of mass processing of data on multiuser ES computer are proposed.Magnetic tape accumulators, the main advantge of which consists in high capacity and acceptable exchange rate, are used for mass data processig, which includes three main stages: selection of initil data sets from the file, processing itself and transmission of resulting data sets to the file. Decentralized organization of associated assignments appears to be a characteristic feature of mass data processing structure. Dynamic adjustment is performed using directive language, software is written in FORTRAN and ASSEMBLER languages. Organization of mass data processing from BIS-2 spectrometer is considered. Application of the means proposed increases the rate of mass data processing using a multiuser computer and increases the system efficiency 5-6 times as compared to traditional approaches. 7 refs.; 1 fig.

52014 (KEK—87-19, pp 88-105) **Particle identification for ASTROMAG detector.** Watase, Yoshiyuki. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Oct 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

Particle identification with a transition radiation detector was discussed for the ASTROMAG project which measures energy spectra of the cosmic particles in the space. The transition radiation detector stands for the wide energy range of the cosmic particles. The tentative design of the transition radiation detector is shown.

52015 (KEK—87-19, pp 106-110) **Effects of solenoid wall in experiments.** Fujii, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

52016 (KEK—87-19, pp 80-87) **SSD as position detector for ASTROMAG.** Tanimori, Tohru. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

Astromag is designed to be used in space stations. A reduction in the size of an apparatus will decrease the costs for satelite launching and concenquently increase the feasibility of the program. Compared to a wire chamber, a silicon strip detector (SSD) can be smaller in volume by more than 90 percent than a wire chamber. The energy available will by largely limited in a space station, but a circuit for wire chamber requires a power of several W-CH. The power consumption, on the other hand, will be about 1 mW-CH if CMOS VLSI is used in the readout circuits. Furthermore, a wire chamber consists of a large number of components while SSD is basically a simple pile of Si plates, leading to a low frequency of troubles. Since each stripe and VLSI is an independent module, it is not likely that malfunction of the entite system will be caused by a small trouble in a module. Techniques required for developing SSD or other components such as VLSI devices can serve for various purposes in the field of semiconductor industries. The existence of an industrial basis to support their development is advantageous not only in technical aspects but also for cost reduction. Their structures, major features and problems remaining to be solved are also briefly outlined. (Nogami, K.).

52017 (KEK—87-19, pp 145-149) **Comments on isotopes and cascade shower detectors.** Nishimura, Jun. (Institute of Space and Astronautical Science, Tokyo (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

Astromag is expected to make great contributions to investigations of isotopes including D and /sup 3/H in cosmic rays. Calculation of the resolution of a detector that combines a Cerenkov counter and superconductive magnet is shown in the interim report of the Astromag Program. Some methods different from the standard ones given in the interim report are proposed here. For D, a case is assumed where 2 percent of incident D getting into a layer of a substance of about 1 g-cm/sup 2/ placed in a magnetic field undergoes nuclear actions, with about half of the D particles under-

going actions that involve neutrons alone to release protons forward. In this case, the ratio of the curvature radius of the trajectory of D before nuclear collision to that after collision is equal to 2. From this relation, the incident particle can be identified as D and its energy can be determined. For /sup 3/H, there are three different cases because different types of particles are involved. The corresponding ratio is 3 - 2, 3 - 4 and 1 - 2 for P, D and T, respectively. Some considerations are made of this isotope separation method. It may work well for /sup 3/H. It is shown that a small cascade shower detector can be developed by using a calculation procedure to determine the radial distribution of cascade shower from its projected lateral distribution. (Nogami, K.).

52018 **(KFK—4183-B) Multiprocessor system for experiments in nuclear physics.** Neudold, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1986. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754347/JAW.

In the first part of this report, a provisional version of the data acquisition system for the magnetic spectrometer LITTLE JOHN at the Karlsruhe isochronous cyclotron is described. The conceptual ideas of this first version and the problems appearing during the test of its hardware and software components are discussed. Basing on the experience with this system possible extensions and new busstructures are suggested. In the second part, some prototype programs are described, which have been developed in order to test the ADC-systems and the dataways.

52019 **(LA—11348-MS) TRACE: A Monte Carlo code for the efficiency and differential efficiency of multi-element neutron scintillator detectors.** Sailor, W.C.; Byrd, R.C.; Yariv, Y. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016490/JAW.

The response of organic scintillators to monoenergetic neutrons has been calculated using a Monte Carlo approach. The code TRACE is largely based on the well-tested code of Stanton, except that multi-element capabilities, energy-dependent reaction kinematics, and photon loss through attenuation and reflection are introduced. The modeling assumptions and historical development of the Stanton code are first discussed. Pulse height distributions calculated with this code are given and used to explain the roles of various reaction channels and multiple scattering in determining the detector efficiency. Changes introduced into the code in developing TRACE are summarized. Pulse height spectra and total efficiencies for single-element detectors are calculated with both the Stanton code and with TRACE in the energy range 28 < E/sub n/ < 200MeV, and the results are compared to experimental data obtained with the $^{7}Li(p,n)^{7}Be$ reaction. 68 refs., 25 figs., 3 tabs.

52020 **(PTB-FMRB—119) Spectrometric investigation of scattering contribution in photon fields of Cs-137 and Co-60 sources.** Dietz, E.; Guldbakke, S.; Matzke, M.; Schollmeier, W.; Urbach, G. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Forschungs- und Messreaktor). Jun 1988. 44p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754851/JAW.

For calibrating photon dosemeters monoenergetic photon fields with known properties at the point of interest are needed. Usually encapsulated Cs-137 and Co-60 sources are used to determine the response of the dosemeters in dependence on the energy. Due to this encapsulation the photon spectra emitted from the source will be changed. This means that the knowledge of the spectral distribution of the incoming photons at the point of calibration is necessary for determining their contribution to the total kerma. Moreover it is also of interest to know the amount of wall-scattered photons in the calibration fields. With a Ge(Li)- and a 3" x 3" NaI(Tl) detector these influences were investigated. For unfolding of the pulse height spectra of the NaI(Tl) detector the response function of Berger and Seltzer were used. From this unfolded energy distribution of the photons the kerma in air was determined by means of the mass energy transfer coefficients of Hubbell. These values were then compared with the reading of a spherical ionization chamber in the same fields. The measurements were carried out in two different rooms and the distance between source and detector was varied.

52021 **(RNIIRP—87-3) Experience and problems in the development of multi-purpose radioisotope thickness gages.** Mussonov, G.P.; Tsalitis, V.A. (Rizhskij Nauchno-Issledovatel'skij Inst. Radioizotopnogo Priborostroeniya (USSR)). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703476/JAW.

Necessary conditions and general requirements to developing the methods of calibration and self-correction of multi-purpose (wide-range) surface density meters are formulated. Questions of metrological supply of devices of this group are analysed, problems of creating equivalent and natural measures of surface density and automated plotting of transitional dependencies are considered. Concrete results for absorption beta-thickness gauges, their calibration dependence being approximated by two-parameter exponential curve, are presented. 3 figs.

52022 **(SAND—88-2089C) Nuclear event scene generation for sensor design, background algorithm design, and performance evaluation.** Asher, R.B.; Backstrom, R.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-880887—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015260/JAW.

From 32. international technical symposium on optical and opto-electronic applied sciences and engineering; San Diego, CA, USA (14 Aug 1988).

This paper gives the development and examples of synthetic nuclear background scenes. These scenes are compared with nuclear test data. These scenes may be used for sensor design and analysis. 10 refs., 20 figs.

52023 **Calibration factors for Ge detectors used for field spectrometry.** Helfer, I.K.; Miller, K.M. (Environmental Measurements Laboratory, New York, NY (USA)). *Health Physics;* **55**: No. 1, 15-29(Jul 1988).

Calibration factors to convert a measured full-absorption peak count rate to activity in the soil and dose rate in air are given for Ge detectors that are used for field measurements of radionuclides. The appropriate factors for a given detector are derived using three primary parameters: the manufacturer's quoted efficiency at 1332 keV relative to a 7.6 cm (3 in.) long by 7.6 cm (3 in.) diameter NaI(Tl) detector, the detector's orientation in the field (up or down) and the Ge crystal length/diameter ratio. The accuracy of the results obtained by using this simplified calibration technique is estimated to be 10-15%.

52024 **Radiation dose-rate meter using an energy-sensitive counter.** Kopp, M.K. (to Dept. of Energy, Washington, DC). US Patent 4,751,390. 14 Jun 1988. Filed date 17 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A radiation dose-rate meter is described comprising: an energy-sensitive radiation detecting element which generates at an output thereof ionization current pulses having an amplitude proportional to the charge quanta deposited in the radiation detecting element by detected photons of ionizing radiation; a charge-sensitive preamplifier connected to the output of the radiation detecting element; a filter amplifier having a selected filter time constant for generating fixed width pulses at an output thereof in response to each of the step voltage pulses from the preamplifier having an amplitude proportional to the amplitude of each of the step voltage pulses applied to an input thereof; a multi-level discriminator means responsive to the voltage pulses at the output of the filter amplifier for generating a train of count pulses at an output thereof in response to each of the fixed width pulses; and a count rate meter means connected to the output of the multi-level discriminator means of registering the count pulses of each of the train of count pulses as a quantized measure of the radiation dose-rate per unit time of the detected photons of ionizing radiation.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 50545, 50557, 50559, 50567, 50568, 50570, 51383, 51656, 51662, 51909, 51962, 52174, 52495, 52614, 52806, 52815, 52829

52025 **(AERE-R—12663) Erosion in the power-generation and utilisation industries. A review of instrumentation requirements for erosion research and in-situ monitoring in the non-nuclear energy related industries.** Buttle, D.J.; Hemsley, D.J.; Martin, S.; Saunderson, D.H. (UKAEA Harwell Lab. Materials Physics and Metallurgy Div.). Feb 1988. 48p. H.M. Stationery Office, London, price Pound 5.00.

A survey of erosion research and the needs of the energy-generation and utilisation industries for erosion monitoring instrumentation has been carried out. This has revealed the need for robust, economical in-situ instrumentation for continuous monitoring of erosion of surfaces by particulates carried in gas-flows. The possibility of obtaining the necessary information by measuring particle impact noise on probes or component surfaces in the gas-flow has been considered. This technique would use existing acoustic emission technology in a novel form. Preliminary laboratory measurements of signals from small particles at low impact velocities are encouraging. A second need, when wind-tunnel or similar test rigs are used, is for instrumentation for measuring erodent particle size and velocity simultaneously close to target surfaces. Optical techniques adapting existing Laser Doppler technology are proposed. A programme of preliminary studies involving both techniques, but primarily aimed at establishing the feasibility of impact noise as an erosion monitor, has been outlined.

52026 **(BARC—1387) Direct reading on-line flowrate meter for use in radiochemical plant.** Shah, B.V.; Kaimal, C.K.R.; Siddiqui, I.A.; Kumar, S.V. (Bhabha Atomic Research Centre, Bombay (India). Reprocessing Group). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704079/JAW.

A device for measurement and remote direct reading display of the flowrates of streams in a radiochemical plant is described. The device is interposed in the measured stream and consists of a syphon pot with a specially developed attachment on the discharge line. Differential pressure switches are used to trigger a timer device at set levels in the pot and the time required for filling the pot during each cycle is measured and is used to compute and display the flowrate. The device is accurate and reliable and is simple to fabricate and install. It is maintenance-free since it has no moving parts. It is also suggested that a manometer with conductive contacts could be used in place of the d.p. switches. The background and various stages of development of the device are described. The operating data is tabulated and parameters required for plant applications are indicated in detail. A simple method to detect and correct for errors due to drift in d.p. switch setting is also outlined. Sketches of typical syphon pot, the schematic of the apparatus and suggested layout for application in radiochemical plant are also included. (author). 11 figures, 6 tables.

52027 **(CEA-CONF—9342) New automatic processing software for ultrasonic data acquired during ISI.** Horteur, P.; Chauvin, P.; Benoist, P.; Pincemaille, G. (Societe Intercontrole, 94 - Rungis (FR)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 6p. (CONF-8709342—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754780/JAW.

From 4. European conference on nondestructive testing; Londres, UK (13 Sep 1987).

An automatic analysis of the ultrasonic data is performed during in service inspection associated to the french I.S.I machine. The objective of this treatment is to reduce the time of analysis and to improve the quality of the results. This treatment can be achieved through a new computarized UT. equipment and a new software implanted on a HP1000 computer.

52028 **(CEA-CONF—9343) Signal processing of eddy current three-dimensional maps.** Birac, C.; David, D.; Lamant, D. and others. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 8p. (CONF-8709342—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754781/JAW.

From 4. European conference on nondestructive testing; Londres, UK (13 Sep 1987).

Digital processing of eddy current three-dimensional maps improves accuracy of detection: flattening, filtering, computing deconvolution, mapping new variables,.., give new possibilities for difficult test problems. With simulation of defects, probes, probe travels, it is now possible to compute new eddy current processes, without machining defects or building probes.

52029 **(CEA-CONF—9344) Ultrasonic large aperture imaging system.** De Vadder, D.; Samain, E.; Paradis, L. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). 1987. 8p. (CONF-8709342—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754782/JAW.

From 4. European conference on nondestructive testing; Londres, UK (13 Sep 1987).

A new ultrasonic large aperture imaging technique is described. This device combines a focussed transducer as a transmitter, producing a small ultrasonic beam, with N transducers as receivers. We show that is possible to considerably reduce the number of receivers if, on the one hand, we limit the reconstitution process to the emitter beam area and, on the other hand, we ensure that the artefacts, caused by the spatial sampling of the reception, are outside this area. Under these conditions, the result is a high resolution image which does not require large reconstitution processing times. Theoretical and experimental results are given.

52030 **(CEA-CONF—9345) Automatic ultrasonic image analysis method for defect detection.** Magnin, I.; Perdrix, M.; Corneloup, G.; Cornu, B. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 4p. (CONF-8710201—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754783/JAW.

From IEEE ultrasonics symposium; Denver, CO, USA (13 Oct 1987).

Ultrasonic examination of austenitic steel weld seams raises well known problems of interpreting signals perturbed by this type of material. The JUKEBOX ultrasonic imaging system developed at the Cadarache Nuclear Research Center provides a major improvement in the general area of defect localization and characterization, based on processing overall images obtained by (X, Y) scanning. (X, time) images are formed by juxtaposing input signals. A series of parallel images shifted on the Y-axis is also available. The authors present a novel defect detection method based on analysing the timeline positions of the maxima and minima recorded on (X, time) images. This position is statistically stable when a defect is encountered, and is random enough under spurious noise conditions to constitute a discriminating parameter. The investigation involves calculating the trace variance: this parameters is then taken into account for detection purposes. Correlation with parallel images enhances detection reliability. A significant increase in the signal-to-noise ratio during tests on artificial defects is shown.

52031 (CONF-760202—, pp 231-238) **High power radio-frequency and microwave radiation sources: a study of relative environmental significance.** Hankin, N.N.; Tell, R.A.; Athey, T.W.; Janes, D.E. Jr. (Environmental Protection Agency, Silver Spring, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Studies of environmental radiofrequency and microwave radiation, high power radiation sources, and source contributions to existing environmental nonionizing radiation levels have contributed to an understanding of the relative environmental significance of the major high power source categories. Analyses and measurements have produced information relating to radiation characteristics, potential hazard evaluations, and environmental radiation levels associated with high power source categories, which include satellite communication earth terminals, radars (military and civilian), and broadcast transmitters (UHF-TV, VHF-TV, and FM). These results when considered along with other factors such as number of sources in each category, relative numbers of persons possible exposed, and general system operating characteristics and procedures, lead to the conclusion that broadcast transmitters constitute the most environmentally significant source category.

52032 **(DOE/ER/60522—2) Development and applications of photosensitive device systems to studies of biological and organic materials: Progress report, January 1, 1988-December 31, 1988.** Gruner, S.M.; Reynolds, G.T. (Princeton Univ., NJ (USA). Joseph Henry Lab. of Physics). Aug 1988. Contract FG02-87ER60522. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015636/JAW.

Overall goals are to develop and apply low light level electro-optical imaging technologies to biological and materials applications. Accomplishments include: A) Development and evaluation of a new CCD-based x-ray detector. B) Evaluation and application of a reticon-array based x-ray detector. C) Construction of apparatus for high pressure studies of biomembrane phase transitions. D) Demonstration of color image intensification. E) Detection of low light level phenomena. F) Utilizing the DOE developed instrumentation, materials research was carried out on biomembranes, polymers and liquid crystals. These results are described. 16 refs.

52033 **(LBL—24828) Sum-frequency generation for surface vibrational spectroscopy.** Guyot-Sionnest, P.; Superfine, R.; Hunt, J.H.; Shen, Y.R. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 5p. (CONF-880708—1). NTIS, PC A02/MF A01. Order Number DE88016668/JAW.

From Laser materials and laser spectroscopy; Shanghai, China (25 Jul 1988).

Infrared-visible sum-frequency generation can be used for surface vibrational spectroscopy of molecules adsorbed at various interfaces. The highly surface-specific nature of the technique is demonstrated. 6 refs., 3 figs.

52034 **(LBL—25394) Germanium blocked impurity band far infrared detectors.** Rossington, C.S. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88016208/JAW.

The infrared portion of the electromagnetic spectrum has been of interest to scientist since the eighteenth century when Sir William Herschel discovered the infrared as he measured temperatures in the sun's spectrum and found that there was energy beyond the red. In the late nineteenth century, Thomas Edison established himself as the first infrared astronomer to look beyond the solar system when he observed the star Arcturus in the infrared. Significant advances in infrared technology and physics, long since Edison's time, have resulted in many scientific developments, such as the Infrared Astronomy Satellite (IRAS) which was launched in 1983, semiconductor infrared detectors for materials characterization, military equipment such as night-vision goggles and infrared surveillance equipment. It is now planned that cooled semiconductor infrared detectors will play a major role in the "Star Wars" nuclear defense scheme proposed by the Reagan administration.

52035 **(PTB-MA—10) Volume and mass measurements of liquids. Proceedings.** Zander, M. (ed.). (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Mechanik und Akustik). Dec 1987. 218p. (In German). (CONF-8703277—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754358/JAW.

From 74. PTB seminar on volume and mass measurement of liquids; Braunschweig, F.R. Germany (30 Mar 1987).

The report comprises the 10 lectures given at the 74th PTB seminar, which represent the state of the art in the field of liquid flow measurement. The lectures deal with the overflow-pipette as the primary volume standard of PTB, gas elimination devices (compulsory in measuring assemblies with volume meters), measuring assemblies for the reception of milk, electromagnetic flowmeters, vortex-shedding meters, indirect mass measurement from volume and density, direct mass measurement (coriolis flowmeters), pipeline-measurements, level measurement at storage tanks with conventional and optical methods and a development aid project for the set up of test rigs in India.

52036 **(SAND—88-8246) Explosive valve VISAR [Velocity Interferometer System for Any Reflector] testing.** Hardwick, M.F. (Sandia National Labs., Livermore, CA (USA)). Aug 1988. Contract AC04-76DR00789. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016855/JAW.

A new VISAR (Velocity Interferometer System for Any Reflector) has been used to measure velocities in explosively actuated valves and related components. This report discusses how a VISAR operates, describes the new system configuration, and presents some test results. 3 refs., 8 figs.

52037 **(UCRL—99265) Holographic measurement of ejecta from shocked metal surfaces.** McMillan, C.; Whipkey, R. (Lawrence Livermore National Lab., CA (USA)). 20 Jul 1988. Contract W-7405-ENG-48. 7p. (CONF-8808103—1). NTIS, PC A02. Order Number DE88015446/JAW.

From 18. international congress on high-speed photography and photonics; Xian, China (28 Aug 1988).

We describe a holographic system that measures the size distribution of particles ejected from a shocked lead surface at speeds up to 2.8 mm/μs. Observed diameters range from 3 μm to 50 μm. The three-dimensional distribution of the particles permits inferences about the uniformity of their distribution and velocity. Comparison of the holographic results for the mass with those obtained using a momentum transfer technique show general agreement but indicate that further refinement of both techniques may be necessary. 5 refs., 5 figs.

52038 **Linear theory of an electron cyclotron autoresonance maser with a "phase filter".** Chen, L.; Kho, T.H.; Chen, K.R.; Lin, A.T. (Physics Department, University of California at Los Angeles, Los Angeles, California 90024). *Physics of Fluids;* **31**: No. 10, 3116-3119(Oct 1988).

The linear growth rate of an electron cyclotron autoresonance maser (CARM) with a phase filter, constructed by imposing a transverse magnetostatic wiggler, is derived from relativistic kinetic theory. The theoretical results confirm previous findings from computer simulation showing substantial enhancement of the growth rate near the autoresonance condition. This theory provides an additional, more readily accessible tool for designing a novel phase filter-assisted CARM. The mathematical formalism developed to treat the complex electron motion in this device is introduced.

52039 **Gyrophase-coherent electron cyclotron maser.** Kho, T.H.; Lin, A.T.; Chen, L. (Physics Department, University of California at Los Angeles, Los Angeles, California 90024). *Physics of Fluids;* **31**: No. 10, 3120-3126(Oct 1988).

The basic physics of an electron cyclotron maser driven by a coherently gyrophased, helical electron beam in a uniform magnetic field is analyzed. Theoretical predictions of gain enhancement and reduction in different regimes of the cyclotron instability, compared to a gyrotropic cyclotron maser, are verified with computer simulations. A physical explanation is presented for these findings. Beam-to-radiation energy conversion efficiency in the autoresonance regime is studied with computer simulations and compared with that for a gyrotropic beam.

52040 **Observations of internal beam production in barium titanate phase conjugators.** Nowak, A.V.; Moore, T.R.; Fisher, R.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* 5: No. 9, 1864-1878(Sep 1988).

We have observed a variety of internal beam configurations in photorefractive $BaTiO_3$ pumped by a cw Ar^+ laser at 514.5 nm. Among these configurations was a total-internal-reflection ring resonator contained entirely within the crystal, with light circulating unidirectionally in the plane of the beam fanning. Phase-conjugate responses were in general found to depend critically on system parameters, in particular, on the separation between the pump focusing lens and the crystal. During the pulsation mode of the phase-conjugate reflection, a sudden frequency shift of 5—10 Hz was observed to occur during the pulse's trailing edge. Certain internal beam patterns were found to be frozen into the crystal and were nearly invariant to small lateral motions of the pump beam across the crystal. Phase-conjugate returns, which would appear to the naked eye to be cw, were often found to possess nearly periodic fluctuations in amplitude and in center frequency.

52041 **(ORNL/tr—88/17) Japanese Industrial Standard resistance bulbs.** Kogyo, Nihon; Chosakai, Hyojun. (Oak Ridge National Lab., TN (USA); Ministry of International Trade and Industry, Tokyo (Japan)). 1988. Contract AC05-84OR21400. Translation of Japanese Standard JIS C 1604, 1981. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014706/JAW.

The specification covers the requirements for platinum resistance bulbs used for thermometry. The units and numerical values given in parentheses in this specification are from the System of International Units (SI) and are given for reference purposes.

52042 **Detection of contaminants in steel tubing using infrared reflection spectroscopy.** Ottesen, D.K. (Sandia National Labs., P.O. Box 969, Livermore, CA (US)). pp 226-233 of Optical techniques for industrial inspection. Cielo, P.G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

The authors used Fourier transform infrared (FTIR) spectroscopy to evaluate the contamination of stainless steel tubing with inner diameters of less than one mm, and lengths of 25 to 100 mm. They discuss the development of a non-destructive analytical technique which is sensitive to both organic and inorganic contaminants which may arise during fabrication processes. Experimental results are compared with theoretical calculations for thin films of hydrocarbon lubricants and metal oxides on metallic surfaces. The main advantages of infrared measurements are their non-destructive nature, ease of application, short measurement times, and the ability to interface the necessary auxilliary optics with existing FTIR instruments. The sensitivity of the technique and its application to the evaluation of current cleaning processes is presented.

52043 **Automatic, transparent, thin-film-thickness inspection system for complex-shapes.** Corey, H.S. (Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., P.O. Box Y, Building 9998, Oak Ridge, TN (US)). pp 128-134 of Optical techniques for industrial inspection. Cielo, P.G. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

An automatic, transparent, thin-film-thickness inspection system for complex shapes is discussed. The basic elements of the system are a light section microscope (LSM) used to produce an optical signal proportional to the film thickness and a multiple-axis robot used to automatically position the LSM at the desired inspection points. The system measures film thickness from 0.013 to 0.250 mm (0.0005 to 0.010 in.) and has a repeatability of +-0.003 mm (+-0.0001 in.). The major development efforts consisted of (1) designing a vision system for the LSM, (2) providing for automatic readout of the film-thickness data, and (3) final positioning of the LSM using the viewed optical patterns. Also, a simple standard was designed and fabricated that provides for traceability to the National Bureau of Standards (NBS) using a coordinate measuring machine. The completed inspection system has been installed in a production shop.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 50549, 50550, 50566, 50569, 50570, 51843, 51854, 52036

52044 (MMIJ—8801, pp 325-326) **Problematical points of practical blasting and blasting experiment.** Honma, Hisao; Higuchi, Kiyoshi. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

There are problems in the calculation method of blasting coefficient of the practical blasting, but on the other hand, there are those who deny the above from their experience of practical blasting. Therefore, it is necessary to consider whether or not the practical experience of blasting does become the absolute yardstick. This article provides an explanation on the problematical points of practical blasting. The Hauser formula has long been adapted very well as the practical formula and as result, has well been used, but (the calculation method of blasting coefficient C and the blasting phenomenon which becomes the basis for it), which is a part of the Hauser theory, is questionable. It has been believed that irrespective of blasting coefficients (excess charge and weak charge) of big blasings, the breaking angle is almost constant and in an actual big blasting plan, C=0.5 is presumed for and hill. No theory is behind the above practice. In other cases too, rules of thumb have well been adapted. In so far as practical blastings are concerned, generally it is the field technique that the standardized design is judged to bring the standardized result irrespective of a few changes of conditions. Many of the blasting theories show no practical numerical values for designing, consequently is powerless in this respect.

52045 (MMIJ—8801, pp 327-328) **Basic research on urban structure blasting.** Honma, Hisao; Higuchi, Kiyoshi. (Hokkaido Univ., Faculty of Engineering, Sapporo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceeding of 1988 Spring symposium of The Mining and Metallurgical Inst. of Japan.

Blasting theories are multifarious and have no common general solution. The conventional empirical formulae present various problems from the standpoints of the results of various experiments. In this article, the basic problems on blasting are examined in connexion particularly with urban structure blasting which has recently been authorized in Japan too. For a sample for blasting, a mortar block of 30cm cube was made and in its center, a vertical blasting hole was provided. With this, an internally charged blasting was conducted and as blasting explosives, a No.6 blasting cap and blasting gelatine were used. Weights and flight distances of crashed fragments vis-a-vis the changes of the amount of explosives were measured and the destruction conditions were sketched. With regard to the strength comparison as bs of the kinds of mortar rocks a and b, the comparison between their degrees of good fracturing effects was ae be and remained the same in a wide range from weak charge to excess charge. In comparing the proper blasting coefficients for urban blasting which were obtained from this experiment with those shown in other references, it is clear that blasting can be executed in the order far smaller than the commonly shown blasting coefficients. Accordingly, it is dangerous to apply without modification the extrapolated feeling on the conventional practical blasting to the designing of urban blasting. (5 figs, 4 tabs)

52046 **(PTB-W—33) 4th safety colloquium on explosion protection. Proceedings of the 80. PTB-seminar.** Steen, H. (ed.). (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Waerme). Dec 1987. 136p. (In German). (CONF-8709343—). NTIS (US Sales Only), PC A07. Order Number DE88754583/JAW.

From 4. safety colloquium on explosion protection; Braunschweig, F.R. Germany (9 Sep 1987).

The 8 papers outline the tasks and activities of the PTB and BAM on the safety sector. The papers contain direct information on the types and geometries of industrial facilities which may cause ignition hazards. The development of measuring and testing techniques for assessing explosion and ignition hazards and protective measures is illustrated by a few examples, e.g. the agreement on the minimum ignition energy for inflammable and nonflammable gases and vapours. Among the examples are a pressure-tight plastic casing, the resistance of transport containers against explosion shocks, thermal effects in pyrotechnics, and the future DECHEMA data base for safety parameters.

52047 **(UCID—21451) Users guide for 2DJET analysis of shaped charges.** Murphy, M.J. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1988. Contract W-7405-ENG-48. 22p. NTIS, PC A03. Order Number DE88016181/JAW.

2DJET is a couple analytic/finite element tool for modeling the high explosive detonation, liner collapse, and resulting jet configuration of a shaped charge. The methodology combines analytic closed-form equations that describe shaped charge jet formation with a hydrodynamic finite element code. The 2DJET approach involves running DYNA2D to describe the explosive detonation and liner collapse process. A jetting routine is called every cycle from DYNA2D to determine the collapse parameters and collapse time, which are then used to define the resulting jet configuration using PER jet formation theory. 17 refs., 5 figs., 7 tabs.

4502 Nuclear

REFER ALSO TO CITATION(S) 50850, 51407, 51581, 51737, 51858, 51860, 52022

52048 **(AD-A—193869/5/XAB) AFWL (Air Force Weapons Laboratory) vectorized EPHULL (Elastic/Plastic HULL) code user manual. Final report, March 1985-May 1986.** Bell, R.L. (New Mexico Engineering Research Inst., Albuquerque (USA)). Feb 1988. 154p. (NMERI-WALL—2). NTIS, PC A08/MF A01.

This report was prepared as a user manual for implementing the vectorized Elastic/Plastic HULL (EPHULL) Composite HULL code and SAIL code on the AFWL CRAY computer. Major programs required to operate the Composite HULL code and supporting programs and files on the AFWL CRAY are described. The Composite HULL code developed through this work is usable over the range of problems formerly accommodated by either Vector HULL or EPHULL, and is simpler and less time-consuming for new users to learn. The Cylinder In Situ Test (CIST) Equation of State (EOS) in this manual was rewritten from the California Research Arbitrary Lagrangian-Eulerian (CRALE) code for use with a variety of soils.

52049 (UCRL—53615-86, pp 3-8) **Containment.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The primary mission of the Containment Group is to ensure that underground nuclear tests are satisfactorily contained. The main goal is the development of sound technical bases for containment-related methodology. Major areas of activity include siting, geologic description, emplacement hole stemming, and phenomenological predictions. Performance results of sanded gypsum concrete plugs on the Jefferson, Panamint, Cornucopia, Labquark, and Bodie events are given. Activities are also described in the following areas: computational capabilities site description, predictive modeling, and cavity-pressure measurement. Containment publications are listed. 8 references.

52050 **(UCRL—99415) Beating words into plowshares: A proposal for the peaceful uses of retired ICBM launchers.** Morgan, T. (Lawrence Livermore National Lab., CA (USA)). 12 Aug 1988. Contract W-7405-ENG-48. 19p. (CONF-8808101—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015435/JAW.

From International seminar on nuclear war; Eriche, Italy (19 Aug 1988).

Any future agreement between the superpowers regarding standing arsenals of intercontinental ballistic missiles will undoubtedly feature dramatic reductions in their numbers. Recent history suggests that the surplus missiles must be destroyed in order to provide a secure and mutually verifiable means of ensuring compliance. But demolition of the START inventories in turn denies their utility as a valuable scientific resource. In keeping with the spirit of START, this paper suggests that the demands of mutual verification and peaceful civilian needs can be reconciled by jointly and cooperatively using the idled ICBM launchers to exploit the scientific and commercial promises of space. 12 refs., 4 figs.

52051 **Similarity analysis of condensing flow in a fluid-driven fracture.** Griffiths, S.K.; Nilson, R.H. (Sandia National Laboratories, Livermore, CA 94550). *Journal of Heat Transfer;* **110**: No. 3, 754-762(Aug 1988).

Similarity solutions are derived for some fundamental problems of condensing flow in a hydraulically driven fracture. The governing equations describe one-dimensional homogeneous turbulent flow along a wedge-shaped hydraulic fracture in an elastic medium. The instantaneous fracture speed is determined as an analytical function of fracture length, material properties, process parameters, and a single eigenvalue, which is calculated by solving a system of ordinary differential equations for the variation of pressure, energy, velocity, and opening displacement along the fracture. Results are presented for abrupt condensation of a pure substance and for gradual condensation of air/water mixtures. The rate of condensation is controlled by the rate of heat transfer to the fracture wall, which depends upon a single-phase flows of vapors and liquids. Although most of the results are presented in dimensionless form, some numercial examples are given for steam-driven fractures emanating from the cavity resulting from an underground nuclear explosions.

4503 Explosion Detection

52052 (UCRL—53615-86, pp 13-17) **Seismology/applied geophysics.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Seismology/Applied Geophysics (SAG Group uses its talents to support many programs and projects throughout the Laboratory, including the Seismic Monitoring Project, the Nuclear Test Containment Program, the Nuclear Waste Management Program, the Unconventional Gas Program, the LLNL Site Seismic Program, and the Basic Energy Sciences Program. The SAG Group emphasizes a multidisciplinary approach to problems. Expertise in the group covers a very broad spectrum; its strengths lie in the areas of seismic research; seismic instrument development; borehole geophysics; geostatistics; logging tool design; structural geology; and seismic processing, analysis, and interpretation. In addition, group members provide program management for several LLNL programs including Seismic Monitoring, the LLNL Site Seismic Program, and the LLNL Seismic Observatory. 1986 accomplishments are summarized and recent publications are listed. 32 references.

52053 (UCRL—53615-86, pp 51-55) **Geomechanics.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Geomechanics Group is composed of scientists with expertise in the mechanics of geologic materials. Most of the group's activity is related to developing and applying sophisticated computer models to the analysis of complex problems of shock, fracture, and flow in the solid earth. The phenomena the group studies generally involve one or more couplings between thermal, mechanical,

and hydraulic effects. The group provides support to LLNL energy projects, such as the isolation of nuclear waste or the recovery of deep natural gas, and to defense programs, such as the containment of underground nuclear tests or the ground effects of earth penetrator weapons. Three projects highlight the achievements of the group in 1986: ground response to nuclear weapons detonations; quasi-static and dynamic fracture propagation driven by fluids, and multi-material gauges to estimate dynamic ground stresses. Recent publications on geomechanics are listed. 28 references.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

52054 (ANL—88-31) Environmental Research Division technical progress report: January 1986--October 1987. (Argonne National Lab., IL (USA)). Jul 1988. Contract W-31109-ENG-38. 267p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88016165/JAW.

Technical process in the various research activities of Argonne National Laboratory's Environmental Research Division is reported for the period 1986-1987. Textual, graphic, and tabular information is used to briefly summarize (in separate chapters) the work of the Division's Atmospheric Physics, Environmental Effects Research, Fundamental Molecular Physics and Chemistry, and Organic Geochemistry and Environmental Instrumentation Programs. Information on professional qualifications, awards, and outstanding professional activities of staff members, as well as lists of publications, oral presentations, special events organized, and participants in educational programs, are provided in appendices at the end of each chapter. Individual projects under each division are processed separately for the data bases.

5001 Basic Studies

REFER ALSO TO CITATION(S) 51856, 51926, 51933, 52477

52055 (CRIE-T—87023) Lightning observation at the Japan sea coast in winter season with the automatic lightning path photographing equipment (Part 4). Tada, Tashika; Fujinami, Hideo. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1987. 21p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754534/JAW.

This paper describes the observational results of lightning in winter season based on the characteristics measured with the developed photographic observational equipment, and the development of three kinds of observational equipment to further elucidate the characteristics of lightning in winter season. The following results were obtained by the analysis of the photographic observational results on the characteristics of winter lightning: As one feature of winter lightning, once lighting is generated, lightning tends to occur frequently and concentrically in a relatively short period. In contrast to lightning in summer season, only the barrier effect of high towers is a characteristic of winter lightning useful for lightning resistant designs. The lightning current is increased as compared with that at the leading stroke during the lightning. For a specific lightning path, it was found that as soon as lightning struck the earth at three points, an inter-cloud lightning discharge of about 1.5 - 2 km in horizontal length was generated, and lowered to the one-fourth of the height of the cloud bottom. The newly developed equipment is a wide band recorder for lightning discharge current wave form, a discriminating system of lightning discharge polarity, and a high response automatic camera. (11 figs, 4 tabs, 4 refs)

52056 (ECN—88-110) An update of below-cloud scavenging efficiencies. Janssen, A.J. (Netherlands Energy Research Foundation, Petten). May 1988. 9p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In a previous report (ECN-87-068) a model was presented which described in detail the below-cloud scavenging process of important atmospheric pollutants. Contributions of in-cloud scavenging and below-cloud scavenging to annual averaged wet depositions in the Netherlands have been estimated with this model, using various measured pollutant concentrations and meteorological data. Unfortunately, no experimental information on the average cloud-base height was available. This height was estimated to be 800 m. A sensitive study with the model revealed, not surprisingly, that the assumed value had a considerable influence on the calculated below-cloud contribution to the wet deposition. More accurate values of the cloud-base height should therefore be used. Such values are now available; they are based on observations by KNMI (Royal Dutch Meteorological Institute). The calculations described in report ECN-87-068. This report gives the updated results. 2 refs., 4 tabs.

52057 (GKSS—87/E/62) Investigations on the Mie and Rayleigh scatterings as a basis for the development of a Rayleigh temperature lidar by Michelson interferometry. Schmidt, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Physik; GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 165p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754298/JAW.

This paper analyses the possibilities and problems of a long distance temperature measurement with Michelson interferometers. To get a precise temperature information from the linewidth of the Rayleigh-scattering it is necessary to quantify the intensity of the aerosol signal, because this signal represents a strong disturbance. Experimental scattering studies are made with a scattering chamber that can be filled with aerosols of different concentrations to simulate the scattering conditions along a vertical profil in the troposphere. With good success an angular compensated Michelson interferometer is used to demonstrate the possibility of a quantitative determination of the aerosol signal. (orig./HP) With 72 figs., 8 tabs., 61 refs.

52058 (GSF—31/87) EXAIR, an analytical transport model for the atmospheric mixing layer. Trenkle, R.; Muenzer, B. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien). Dec 1987. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754579/JAW.

EXAIR is an evaluative, regional-scale exposure model for the atmospheric transport of substances. The problem of atmospheric properties was solved by using the complete weather statistics of Karlsruhe Nuclear Research Center. The model links environmental parameters and substance parameters. Further, EXAIR assumes atmospheric dispersion only in the mixing layer with the so-called 'transport wind', i.e. height-averaged wind. Dispersion is limited by two substance-specific depletion processes, i.e. deposition and photodegradation.

52059 (NP—9770415) Protection of the earth atmosphere. A BMFT survey on research activities investigating into selected fields of atmospheric and climatic research - to be submitted to the Enquete Commission. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 28 Jan 1988. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88770415/JAW.

The BMFT survey informs about the research activities investigating into the greenhouse effect, climatic impacts, the enrichment of ozone and other trace elements as well as their transport to the troposphere, the degradation of ozone in the stratosphere. The survey discusses the respective problems, present knowledge, data and results of research programs and provides a bibliography on each of the subjects referred to. The report will be submitted to the enquete commission on 'precautions to be taken to protect the earth atmosphere'. (HSCH).

52060 **Methodology for understanding and intercomparing atmospheric climate feedback processes in general circulation models.** Cess, R.D.; Potter, G.L. (Institute for atmospherice sciences, State University of New York at Stony Brook). *Journal of Geophysical Research;* **93**: No. D7, 8305-8314(20 Jul 1988).

Based upon the need to understand differences between general circulation model projections climatic change due to increasing atmospheric carbon dioxide, the present study first categorizes reasons for these differences and presents suggestions for the design of future climate model simulations, so that these specific categories may directly be addressed and understood. Following this, and based upon tutorial use of a radiative-convective model, it is suggested that sea surface temperature perturbations may be used, in conjunction with separation of clear and overcast regions within a model, as a surrogate climatic change for the purpose of understanding and intercomparing atmospheric climate feedback processes. This approach is illustrated through use of the Oregon State University/Lawerence Livermore National Laboratory general circulation model, with particular attention being paid to interpreting cloud/climate interactions within the model. copyright American Geophysical Union 1988

52061 **Smoke optical depths: magnitude, variability, wavelength dependence.** Pueschel, R.F.; Livingston, J.M.; Russell, P.B.; Colburn, D.A.; Ackerman, T.P.; Allen, D.A.; Zak, B.D.; Einfeld, W. (NASA Ames Research Center, Moffett Field, California). *Journal of Geophysical Research;* **93**: No. D7, 8388-8402(20 Jul 1988).

The Ames airborne, autotracking sunphotometer has been operated aboard a Sandia Laboratories research aircraft to measure magnitudes, temporal/spatial variabilities, and wavelength dependence of optical depths in the near-ultraviolet to near-infrared spectrum of smoke from two forest fires and one jet fuel fire and of background air. The results were corrected for Rayleigh scattering and for estimated absorption by ozone and nitrogen dioxide. Characteristic differences in the aerosol optical depths of background atmospheres and of different types of smokes are the following (1) the magnitude and wavelength dependence of "background" optical depths vary with the geographic location at which the measurements are performed; (2) the wavelength dependence of smoke optical depths depends on the fuels that feed the fires and on the residence time of the smoke cloud in the atmosphere. In general, the jet fuel smoke optical depths tended to be less wavelength dependent (near-ultraviolet to near-infrared) than background aerosol optical depths. Forest fire smoke optical depths showed a wide range of wave-length dependences, including incidents of wavelength-independent extinction. copyright American Geophysical Union 1988

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 50517, 50526, 50529, 50531, 50580, 50926, 51229, 51230, 51231, 51232, 51369, 51484, 51573, 51576, 51740, 51741, 51742, 51743, 51753, 51934, 51935, 51936, 52058, 52059, 52101, 52149, 52438, 52439, 52443

52062 **(BBCER—8403) Evaluation of reforming as a practical technique for the elimination of water pollution from wood gasifiers.** Black, J.W. (BBC Engineering and Research Ltd., Markham, Ontario (Canada)). Mar 1984. 110p. (CE—01825). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

As a first step in the evaluation of the viability of reforming as a technique for the elimination of pollution from gasifier condensate, many of the major constituents were identified from literature sources. A theoretical evaluation of equilibrium constants for the reaction indicated that reformation could be an effective solution. Next an experimental evaluation confirmed that the technique could reduce the contaminants to low levels under relatively mild conditions with catalysts ranging from limestone to typical industrial reforming agents. The reaction appears to be diffusion limited and, as a result, low cost materials, such as limestone, are as effective as conventional nickel catalysts. When extrapolated, these data indicate that the process can be applied to different kinds of gasifiers over a broad size range to reduce pollution levels to acceptable values. Two applications involving a fixed bed and a fluidized bed are discussed. A very preliminary evaluation indicates that reforming is as effective, if not more so, than other developing technologies. Because of the simplicity of the technology, it is anticipated that it will remain competitive with other technologies as these systems become developed. 25 rfs., 15 figs., 22 tabs

52063 **(BNL—41535) Back trajectory analysis for PRECP-III.** Benkovitz, C.M.; Leach, M.J. (Brookhaven National Lab., Upton, NY (USA)). May 1988. Contract AC02-76CH00016. 79p. NTIS, PC A05. Order Number DE88015814/JAW.

Back trajectory analyses were conducted for the PRECP-III field period, January 12, 1986 to February 12, 1986 using the Branching Atmospheric Trajectory (BAT) model developed at the Air Resources Laboratory of the National Oceanic and Atmospheric Administration. These trajectories were centered at the field station at Sandy Pond, New York. Previous work that studied the uncertainties encountered when using trajectory models was reviewed, and results of a verification study to select the appropriate meteorological window for the input data to the BAT model are presented. Anthropogenic emissions of SO/sub x/ and NO/sub x/ in the geographic area covered by the calculated trajectories were obtained from the emissions inventory project of the National Acid Precipitation Assessment Program (NAPAP). The emissions were allocated to a 1{degree} by 1{degree} grid and displayed over maps of the area. 11 refs., 11 figs., 2 tabs.

52064 (CONF-760202—, pp 705-715) **Computer handling of Savannah River Plant environmental monitoring data.** Zeigler, C.C. (E. I. du Pont de Nemours and Company, Inc., Aiken, SC (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

At the Savannah River Plant, computer programs are used to calculate, store, and retrieve radioactive and nonradioactive environmental monitoring data. Objectives are: to provide daily, monthly, and annual summaries of all routine monitoring data; to calculate and tabulate releases according to radioisotopic species or nonradioactive pollutant, source point, and mode of entry to the environment (atmosphere, stream, or earthen seepage basins). The computer programs use a compatible numeric coding system for the data, and printouts are in the form required for internal and external reports. Data input and program maintenance are accomplished with punched cards, paper or magnetic tapes, and when applicable, with computer terminals. Additional aids for data evaluation provided by the programs are statistical counting errors, maximum and minimum values, standard deviations of averages, and other statistical analyses.

52065 **(CONF-8805183—1) Tropospheric ozone and vehicular emissions.** Russell, M. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015562/JAW.

From National Academy of Engineering inaugural symposium; Irvine, CA, USA (11 May 1988).

The paper examines changes in the transportation system as a means of reducing tropospheric ozone in the South Coast Air Basin of California. It takes this issue as a paradigm for the broader national situation where there are environmental risks for which no plausible, politically or economically acceptable remedies exist. It summarizes the health risks of ozone, the current and prospective levels of control required to avoid them, the prospective contribution of transportation controls, and the information required to put the issue in a social benefits and costs framework for decision. 23 refs.

52066 **(CONF-8806200—1) United States position paper on sodium fires: Design basis and testing.** Lancet, R.T.; Johnson, R.P.; Matlin, E.; Vaughan, E.U.; Fields, D.E.; Gluekler, E.; McCormack, J.D.; Miller, C.W.; Pedersen, D.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. (CONF-8806200—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015292/JAW.

From International Atomic Energy Authority meeting on sodium fires; Obninsk, USSR (6 Jun 1988).

When aerosols generated by sodium fires are released to the atmosphere, they are of concern in two primary areas. First, these aerosols may adversely impact the health of persons exposed to them. Second, the air intake ports that are used for reactor cooling might suffer restricted flow under high aerosol concentrations. We have performed studies related to both of these areas. The Gaussian plume atmospheric dispersion model (Slase 1968) is the most widely used approach for modeling the atmospheric concentration and deposition of aerosols for health impact assessments. We have compared predictions from one implementation of this model (Fields and Miller 1980) with actual measured air and ground concentrations for sodium aerosols released to the atmosphere (Miller, Fields, and Wiseman 1982). The observed values used in this study come from seven atmospheric sodium release tests conducted at the Idaho National Engineering Laboratory (INEL) during 1978 and 1979. An important consideration when evaluating the possible consequences of a sodium fire is the sodium aerosol concentration at the air intake ports that are used for reactor cooling, which may suffer restricted flow under high aerosol concentrations. We have devised and applied a methodology for estimating the concentration of aerosols released vertically and horizontally from building surfaces and monitored at other building surface points. We have used this methodology to make calculations that indicate the time development of aerosol buildup, and the maximum aerosol concentrations, at air intake ports. 12 refs., 1 fig., 2 tabs.

52067 **(CRIE-T—86094) Objective method for assessing monitoring network.** Kato, Hisashi; Nishinomiya, Sho. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1987. 46p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754532/JAW.

In order to rationalize the existing monitoring network (reduction of the observation points), an objective method for proper network systems was developed, and the model calculation was conducted in three areas. This study puts great emphasis on improvement of the setting of representative region in each area, which is one of the most important problems to give a proper network system. In addition, for obtaining an objective network system, a multi-variate analysis (combination of the principal component and the cluster analyses) was employed. The resultant new network system should be satisfactory for monitoring SO_2 and NOx, the general atmospheric environments, and the influence by exhaust smoke from the power plant. The presentative regions were defined based on the similarities of temporal variations in SO_2 or NOx concentration. It has been revealed that a series of the techniques employed in this study can give a proper network system with the observation points decreased for any area, as compared with the number of the existing observation points. (36 figs, 10 tabs, 13 refs)

52068 **(DOE/ER/60292—4) Operation and research at the Ithaca MAP3S regional precipitation chemistry site: Annual progress report for 1988.** Butler, T.J.; Likens, G.E. (New York Botanical Garden, NY (USA). Inst. of Ecosystem Studies). Jul 1988. Contract FG02-85ER60292. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015269/JAW.

Ten complete years of precipitation chemistry data, 1977 to 1986, are summarized for the Ithaca MAP3S site. For comparison purposed selected data from the eight other MAP3S sites are included. Notable findings include the following: 1) Monthly concentrations of H^+, SO_4/sup 2{minus}/, NO_3/sup {minus}/, and NH_4^+ show a high degree of variability from year to year. 2) The Ithaca Site shows a statistically significant ($p = 0.05$) decline, from 1977 to 1986, in annual volume-weighed H^+ concentration. 3) A statistically significant ($p = 0.05$) increase in annual volume-weighted NH_4^+ concentration also occurs for this time period at the Ithaca site. 4) Ohio, from 1979 to 1986, shows a significant ($p = 0.05$) decline in volume-weighted H^+ and SO_4/sup 2{minus}/ concentration. 5) While there is not a significant ($p = 0.05$) linear relationship between emissions of SO_2 and SO_4/sup {minus}/ concentrations, and emissions of NO/sub x/ and NO_3/sup {minus}/ concentrations, there is a significant positive relationship for emissions of SO_2 plus NO/sub x/ versus H^+ concentrations at Ithaca ($p = 0.10$) and Ohio ($p = 0.05$). 6) 15% to 30% of dry-deposited particles at the Ithaca site are anthropogenicly derived. On a mass basis, one third of the calcium species are $CaSO_4$, probably derived from the conversion of $CaCO_3$ interacting with SO_2 or acidic sulfate. Experimental results suggest this conversion can occur at rates from 0% to 20% per day in the Ithaca area. 13 refs., 23 figs., 2 tabs.

52069 **(ECN—88-129) Some aspects of annual variations in meteorology and air pollution.** Janssen, A.J. (Netherlands Energy Research Foundation, Petten). Jul 1988. 52p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The annual variability in meteorological conditions is an interfering factor in the search for a correlation between changes in emissions of air pollution and resulting concentration in the air and precipitations. Some aspects of this interfering factor are considered, using calculations from the IE model for large-scale transportation of air pollution. The annual concentration and deposition in the Netherlands of six polluting components were calculated, using the meteorology of three different years and with the assumption of unchanged European emissions in those years. Then the possible support of model calculations in trend analysis is considered, implemented for ECN-measurements (ECN is Netherlands Energy Research Foundation) of the composition of precipitations. In this analysis daily measured data per year are divided into groups with significant different average structure. The model calculations showed that this group division correlates with meteorological conditions. The available series of measurements are not long enough to make detailed statements about trends. 26 figs., 7 refs., 8 tabs.

52070 **(EPA—230-05-86-013) Greenhouse effect, sea level rise, and coastal wetlands.** Titus, J.G. (Ed.). (Environmental Protection Agency, Washington, DC (USA). Office of Policy, Planning and Evaluation). Jul 1988. 156p. Unlimited audience, publicly available. United States Environmental Protection Agency, Washington, DC 20465. Order Number TI88015785/JAW.

To further society's understanding of how to rationally respond to the possibility of a substantial rise in level, EPA has undertaken assessments of the impacts of sea level rise on economic development, beach erosion control strategies, salinity of estuaries and aquifers, and coastal drainage and sewage systems. Those studies have generally found that even a one-foot rise in a sea level has important implications for the planning and design of coastal facilities. This report examines the potential impacts of sea level on coastal wetlands in the United States. Coastal marshes and swamps are generally within a few feet of sea level, and hence could be lost if seal level rises significantly. Although new wetlands could form where new areas are flooded, this cannot happen where the land adjacent to today's wetlands is developed and protected from the rising sea. Once built, neighborhoods can be expected to last a century or longer. Therefore, todays coastal development could limit the ability of coastal wetlands to survive sea level in the next century. Chapter 1 provides an overview of the greenhouse effect, projections of future sea level rise, the basis for expecting significant impacts on coastal wetlands, and possible responses. Chapters 2 and 3 present case studies of the potential impacts on wetlands around Charleston, South Carolina, and Long Beach Island, New Jersey, based on field surveys. Chapter 4 presents a first attempt to estimate the nationwide impact, based on topographic maps. Finally, Chapter 5 describes measures that wetland protection officials can take today. This report neither examines the impact of sea level rise on specific federal programs nor recommends specific policy changes.

52071 **(ESC-WR—88-02) Netherlands data-base (EOS-MARKAL) SO/sub 2/ and NO/sub x/ emission coefficients and abatement techniques.** Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Feb 1988. 12p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Netherlands database EOS-MARKAL contains SO/sub 2/ and NO/sub x/ emission coefficients and data on emission abatement techniques. The complete database has been used in the 1987 MARKAL-runs for the Energy Research Planning Study at the Energy Study Centre within the Netherlands Energy Research Foundation. The database was compiled by the author, with special help from T. Kroon, P. Kroon and P. Lako. Most emission coefficients and data on emission abatements techniques are drawn from three publications stated in the reference list. For some new energy conversion or advanced emission abatement techniques, data have been introduced selected from current scientific literature. Data are given different parts in industry and the residential and commercial sectors. 4 refs., 8 tabs.

52072 **(ESC-WR—88-05) Contribution of the ESC to the System Research Acidification.** Van Arkel, W.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Apr 1988. 49p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In 1984 the Dutch government installed the Steering Committee to investigate acidification. The research program of the committee consists of three main items: a) effects; b) NH/sub 3/ emission; and c) effectivity of control measures. The last item has to do with a system analysis to correlate in a modelling way emissions and effects in order to test the effectivity of measures. The Energy Study Centre, Netherlands (ESC), contributed to the construction of such a demonstration model in 1985. Based on collected results it is decided to continue the formation of the model. As a member of the working group 'EMISSIES' ('Emissions') ESC is commissioned to determine future internal emissions of SO/sub 2/ and NO/sub x/ per sector and region and to contribute to the forming of a database to collect data in a formalized manner. Chapter two of this report elucidates the task. Chapter three gives an overview of the results of the scenarios calculations (energy consumption, emissions of SO/sub 2/ and NO/sub x/, energy demand, energy supplies) and regionalizing of emissions. The import and export of SO/sub 2/ and NO/sub x/ to and from the Netherlands is indicated. 27 figs., 10 refs., 3 tabs.

52073 **(ESC-WR—88-06) On the use of LP-models for analysing and evaluating SO/sub 2/- and NO/sub x/-emissions.** Van Oostvoorn, F. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Mar 1988. 24p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the Congress on environmental policy in a market economy, Wageningen, Netherlands, 8-11 September 1987.

The applicability of LP modelling for long term environmental policy making on a national level is discussed. This class of models proves very useful in modelling the interaction between pollutants and economic activities on a disaggregated (sector) level. The use and applicability of LP models will be demonstrated by presenting the results of several studies on evaluating control policies for SO/sub 2/ and NO/sub x/ emissions. The results show clearly the merits of LP models. 8 figs., 16 refs.

52074 **(ESC-WR—88-07) Emissions of SO/sub 2/ and NO/sub x/ in the Netherlands in the year 2030. Calculations for the benefit of the System Research Acidification.** Van Arkel, W.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Apr 1988. 81p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In 1984 the Dutch government installed the Steering Committee to investigate acidification. Part of the so-called Additional Program Acidification Research concerns the effectivity of control measures. The Energy Study Centre (ESC) Netherlands, contributed to a system analysis to correlate emissions and effects in a modelling way to test the effectivity of measures. As a member of the working group 'Emissies' ('Emissions') the ESC was commissioned to determine with the help of energy scenarios, SO/sub 2/ and NO/sub x/ emission. Via the project 'National Energy Studies' and the related project 'Optimalization Environment Emissions' the needed data for the years 2000 and 2010 are produced. Because there was a demand for data on the SO/sub 2/ and NO/sub x/ emission for the year 2030 the ESC made some calculations for it. This report presents the results and gives account for the followed method. 7 figs., 6 refs., 11 tabs., 1 app.

52075 **(ESC-WR—88-08) Development of SO/sub 2/- and NO/sub x/-emissions in the Netherlands per region. Activities in the frame of the System Research Acidification.** Van Arkel, W.G. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Apr 1988. 50p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

This report describes the activities executed as part of the Additional Program Acidification Research. This program has three subdivisions. One subdivision is a system analysis of the effectivity of control measures. A so-called acidification model is developed to execute the analysis. The Energy Study Centre, Netherlands, is commissioned to elaborate a few energy scenarios until 2030 and to make calculations with the help of the model SELPE (Static ESC Linear Programming Energy), a model for the Dutch energy supply. The energetic and environmental-technical characterizations of the scenarios as well as the energy supply and SO/sub 2/ and NO/sub x/ emissions are recorded in a emission module. The emissions are subdivided into economical sector and original region. The characterizations and data of the scenarios are collected in the emission module, so that they can be used to execute exercitions with the acidification model. This report presents the results of the calculations. 17 figs., 10 refs., 14 tabs.

52076 **(ESC-WR—88-09) To control emissions or adapt energy economy.** Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Apr 1988. 29p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In controlling acid rain and photochemical air pollution, flue gas purification and adaptation of the combustion process to abate NO/sub x/, SO/sub 2/ and C/sub x/H/sub y/ emissions is stressed. In the short term that is justified. But in the long term changes in energy technology and the use of fuels are important as well. This can be concluded from calculations with an optimization model of the Dutch energy economy executed by the Energy Study Centre of the Netherlands Energy Research Foundation (ECN). This report, which is a concept-article for the Dutch magazine 'Lucht en Omgeving', tries to answer the question which energytechnology and fuels are interesting for the future considering the control of acid rain and photochemical air pollution and which are not interesting. The interesting technologies and fuels are fuel cells, absorption-heat-pump, methanol, nuclear energy and wind turbines. An energy technology which is scenario dependable is large scale coal firing. Technologies which are not influenced by emission limits are insolation of domestic buildings, terrestrial heat, electric cars and electric heat pumps. Energy technologies which should be avoided are gasmotors, diesel cars and whirlbed for heat. 7 figs., 26 refs., 5 tabs.

52077 (INIS-mf—11309, pp 154) **Kinetics of sodium binding to ATP.** Pilatus, U.; Junge, V.; Skrandies, S.; Mayer, A.; Lanzerath, U.; Offermann, W.; Leibfritz, D. (Bremen Univ. (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52078 **(IVL-B—840) Control of fuel nitrogen as a measure for limitation of NO/sub x/ emissions.** Dahlberg, K. (Swedish Environmental Research Inst., Goeteborg). (Swedish Environmental Research Inst., Stockholm). Nov 1986. 45p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754400/JAW.

The significance of fuel nitrogen in the NO/sub x/ formation process by coal and oil firing was studied. The connection between oil nitrogen and NO/sub x/ emission is comparatively clear. In the

case of coal the conditions are more complicated, but, in general, a coal of high nitrogen content yields larger amounts of nitrogen oxides than a coal of low nitrogen content. Pulverized coal firing results in considerably larger NO/sub x/ emissions than fluidized bed and stoker firing and oil firing. About 50% of the NO/sub x/ emissions by oil firing emanates from fuel nitrogen. By coal firing the contribution is 80%.

52079 **(IVL-B—848) Emission of nitrogen oxides from pulp and paper industry. Preliminary study.** Bostroem, C.Aa.; Dahlberg, K. (Swedish Environmental Research Inst., Goeteborg). Feb 1987. 19p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88754399/JAW.

The NO/sub x/-emissions from pulp and paper industry is approximately 5% of the total emissions in Sweden. In this report different measures to reduce NO/sub x/-emissions from pulp and paper industry are discussed.

52080 (IZ—8601, pp 1-3) **Studies on highly effective collection method of submicron particles.** Akazaki, Masanori; Hara, Masanori; Sonoda, Yoshihito; Kaneko, Masamitsu. (Kyushu Univ., Faculty of Engineering, Fukuoka, Japan). 20 Aug 1986. (In Japanese). Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

The greatest and most difficult problem yet to be solved on air pollution is to find an efficient method for collecting very small particles. Charged water droplet scrubbers are attracting attention as a means for such collection. In addition, the recent extensive use of low-sulfur brings about an abnormal phenomenon called reverse ionization. A high-temperature EP is attracting attention as a means for preventing this phenomenon. Experiments were conducted to study detailed processes of collection with water droplets in a fine particle collection charged water droplet scrubber and to investigate the behavior of droplets. Also, the behavior of spatial charges in the ion flow field caused by a stable corona and the corona discharge mode in hot air were studied in relation to the corona discharge and ion flow field which serve as the ion source in the high-temperature EP. The results of this study cover the following: (1) Corona discharge mode in hot gas; (2) Similarity law held in the ion flow field in hot gas; (3) Process of collision between fine particles and water droplets; (4) Collective behavior of charged water droplets (12 refs)

52081 **(LBL—25519) Experiments and modeling of the soil-gas transport of volatile organic compounds into a residential basement.** Garbesi, K. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016670/JAW.

This paper presents theoretical and laboratory studies of the advective flow of volatile organics compounds (VOC) through soil, and a field investigation of the pressure-driven entry of VOC into a house adjacent to a municipal landfill. The principals of fluid mechanics are used to derive an analytical model of the pressure-driven flow of VOC in soil. The calculation results in the definition of a retardation factor of VOC with respect to the velocity of the bulk soil gas. The retardation equation is then tested in soil-column experiments using sulfur hexafluoride (SF_6) and hexafluorobenzene (HFB). The measured retardation is in good agreement with the predicted value. These experiments are used to evaluate the potential of SF_6 and HFB as tracer gases for use in a field investigation of the advective flow of soil gas into and near the basement of a house near a landfill and to evaluate the potential of the soil-column apparatus for use in screening the advective mobility of VOC important as landfill gas containments. The field study consisted of experiments investigating the influence of basement depressurization on the surrounding soil gas, and quantifying VOC contamination at the site. Soil-gas entry into the house during artificial basement depressurization was measured using SF_6 as a tracer, and pressure coupling was measured between the basement and the surrounding soil. Measurements of VOC in ambient air, indoor air, and soil gas indicate that a number of halogenated and oxygenated contaminants present in indoor air had a soil-gas source. Particularly high concentrations of dichlorodifluoromethane, trichlorofluoromethane, and tetrachloroethylene were identified in the soil gas. The pressure field generated in the soil around the basement by basement underpressure was modeled using a modified groundwater model. 39 refs., 26 figs., 9 tabs.

52082 **(LIS—73) Establishment of an emission inventory and an emission forecast for furnaces in households and minor industrial plants in the eastern Ruhr district.** Schade, H. (Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.)). 1987. 79p. (In German). Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.).

In LIS-Report No. 48 (1984) a newly developed model for assessing the energy consumption in the burdened urban and industrial area along the Rhine for entry into an emission inventory for households and small consumers has been described for the first time. It strongly follows the methods used for working out future energy supply concepts. The model was further developed and applied to the polluted area of the eastern Ruhr district. Very accurate results were obtained with the model for pipe supplied energy carriers while they were weaker for the use of solid fuels. This required to reintroduce the collective term 'coal'. Using detailed informations concerning the composition of the types of coal burned, emission factors specific for certain regions were obtained yielding results with good accuracy. The total energy consumption was lower by 17% in 1982 than that predicted by the First Air Quality Conservation Program. Larger differences become apparent for the various energy carriers; the fuel oil consumption was grossly overestimated, the gas consumption grossly underestimated. Until the year 1992 the average total energy consumption is expected to drop. This decline is entirely attributable to the liquid and solid fuels while for pipe supplied energy carriers a further increase is to be expected. The emissions will change accordingly. For SO/sub 2/, CO, organic gases and vapors as well as for solid matter an average drop by 25% is expected. For NO/sub x/ the reduction will amount to 11%.

52083 **(NEI-SE—18) Air pollution and acidification. Monitoring and research in Sweden concerning the effects and measures for mitigating them.** (National Swedish Environmental Protection Board, Solna). [1986]. 11p. NTIS (US Sales Only), PC A03. Order Number DE88754411/JAW.

An account is given of the research and monitoring activities that are currently being carried out in Sweden in regard to air pollution and acidification, as well as the countermeasures that are being taken within the country itself to check both. The account thus given reflects the findings of a large number of research projects; the countermeasures arising from them are outlined, and there is a list of the various agencies and institutions involved in the work. The main problems are grouped into the following five areas, with research being carried on in each. 1. Deposition. 2. Forests and soils. 3. Groundwater and corrosion. 4. Surface water. 5. Wildlife. At present the highest priority is being given to studies of forest damage and the effects of acidification on groundwater, although the corrosion of buried structural materials is also tending to receive special attention.

52084 **(ORNL/TM—10825) Review of public alert systems for emergencies at fixed chemical facilities.** Sorensen, J.H.; Rogers, G.O.; Clevenger, W.F. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88016029/JAW.

The purpose of this study is to evaluate: the technology and procedures used to alert the public in the event of a chemical release; the management practices associated with these processes; and the relationship between the facility, emergency system characteristics, and system effectiveness. Data from surveys and secondary sources are used to compare existing public alert and notification systems to the state-of-the-art technology, procedures, and management practices. The research assesses problems and constraints that would interfere with a timely and effective emergency warning and determines where significant improvements can be made in public alert and notification systems or chemical emergencies. 213 refs., 6 figs., 6 tabs.

52085 **(PB—88-215884/XAB) Integrated Risk Information System (IRIS) (for IBM PC/AT microcomputers). Data file.** Picardi, R.; Swartout, J. (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). 31 May 1988. vp. NTISCP D03.

See also PB—88-215892; The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC/AT microcomputer. The diskettes are in the ASCII format.

The Integrated Risk Information System (IRIS), an on-line database of chemical-specific risk information, was made available outside EPA. IRIS provides information on how chemicals affect human health and is a primary source of EPA risk-assessment information on chemicals of environmental concern. The principal section of IRIS is the chemical files. The chemical files contain: oral and inhalation reference doses for noncarcinogens; oral and inhalation carcinogen assessments; summarized Drinking Water Health Advisories; summaries of selected EPA regulations; supplementary data (for example, acute-toxicity information and physical-chemical properties). The two primary types of health-assessment information in IRIS are reference doses and carcinogen assessments. Reference doses are estimated human chemical exposures over a lifetime which are just below the expected threshold for adverse health effects. Because exposure assessment pertains to exposure at a particular place, IRIS cannot provide situational information on exposure. IRIS, can be used with an exposure assessment to characterize the risk of chemical exposure. This risk characterization can be used to decide what must be done to protect human health. Oral reference doses (RfD) are provided for most of the chemicals in IRIS and carcinogen slope factors are provided for some. Inhalation reference doses are not yet available in IRIS. Inhalation reference doses will be added after the Agency produces a methodology for developing these RfDs. For more information on IRIS call IRIS User Support at (513) 569-7254 or FTS 684-7254.

52086 **(PB—88-215892/XAB) Integrated Risk Information System (IRIS) (for IBM PC microcomputers). Data file.** Picardi, R.; Swartout, J. (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). 1988. vp. NTIS CP D06.

See also PB—88-215884; The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC microcomputer. Diskettes are in the ASCII format.

The Integrated Risk Information System (IRIS), an on-line database of chemical-specific risk information, was made available outside EPA. IRIS provides information on how chemicals affect human health and is a primary source of EPA risk-assessment information on chemicals of environmental concern. It is intended to serve as a guide for the hazard identification and dose-response assessment steps of EPA risk assessments. The principal section of IRIS is the chemical files. The chemical files contain: oral and inhalation reference doses for noncarcinogens; oral and inhalation carcinogen assessments; summarized Drinking Water Health Advisories; summaries of selected EPA regulations; supplementary data (for example, acute-toxicity information and physical-chemical properties). The two primary types of health-assessment information in IRIS are reference doses and carcinogen assessments. Reference doses are estimated human chemical exposures over a lifetime which are just below the expected threshold for adverse health effects. Because exposure assessment pertains to exposure at a particular place, IRIS cannot provide situational information on exposure. IRIS can be used with an exposure assessment to characterize the risk of chemical exposure. This risk characterization can be used to decide what must be done to protect human health. Oral reference doses (RfD) are provided for most of the chemicals in IRIS and carcinogen slope factors are provided for some. Inhalation reference doses are not yet available in IRIS. Inhalation reference doses will be added after the Agency produces a methodology for developing these RfDs. For more information on IRIS call IRIS User Support at (513) 569-7254 or FTS 684-7254.

52087 **(PB—88-221940/XAB) OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, Version 4) source code. Software.** Dodge, M.C.; Hogo, H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Jan 1988. mag tap. NTIS CP T08.

Supercedes PB—87-153037; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—88-221957 and PB—88-221965.

A software package was developed to enable a user to estimate EKMA control strategies using a new Carbon Bond Mechanism known as CBM-IV. The program is called Ozone Isopleth Plotting with Optional Mechanisms/Version 4 (OZIPM-4). The program has the capability of accepting a chemical mechanism other than the default CBM-IV that is stored internally in the program. Included with the source code are five examples of OZIPM-4 simulations. The use of the OZIPM-4 program is described in the EPA Report 'User's Guide for Executing OZIPM-4 with CBM-IV or Optional Mechanisms.'...Software Description: The program is written in the FORTRAN programming language for implementation on a PRIME 750+ computer using the REV 19 + operating system. 400K bytes of core storage are required to operate the model.

52088 **(PB—88-221957/XAB) User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, Version 4) with CBM-IV (Carbon-Bond Mechanisms-IV) or optional mechanisms. Volume 1. Description of the ozone isopleth plotting package. Version 4. Final report, July 1985-June 1987.** Hogo, H.; Gery, M.W. (Systems Applications, Inc., San Rafael, CA (USA)). May 1988. 240p. (EPA—600/8-88/073A). NTIS, PC A11/MF A01.

For system on magnetic tape, see PB—88-221940. See also Volume 2, PB—88-221965.

An updated version of the Ozone Isopleth Plotting Program was developed for use with EKMA to calculate emission reductions needed to achieve the air-quality standard for ozone. The program, called OZIPM-IV (Ozone Isopleth Plotting with Optional Mechanisms - Version IV), contains the new Carbon-Bond Mechanism-IV (CBM-IV). In addition to containing a new mechanism, the OZIPM-IV expands on earlier versions of the code by providing a wider compatibility between computers, an improved isopleth plotting package, expanded user interaction with control-strategy calculations and a new option for determining credits for reductions in carbon monoxide emissions. Volume 1 of the report serves as the User's Manual for OZIPM-IV. Volume 2 contains the listing of the FORTRAN computer code.

52089 **(PB—88-221965/XAB) User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, Version 4) with CBM-IV (carbon-bond mechanism-iv) or optional mechanisms. Volume 2. Computer code. Final report, July 1985-June 1987.** Hogo, H.; Gery, M.W. (Systems Applications, Inc., San Rafael, CA (USA)). May 1988. 175p. (EPA—600/8-88/073B). NTIS, PC A08/MF A01.

For system on magnetic tape, see PB—88-221940. See also Volume 1, PB—88-221957.

An updated version of the Ozone Isopleth Plotting Program has been developed for use with EKMA to calculate emission reductions needed to achieve the air quality standard for ozone. The program, called OZIPM-IV (Ozone Isopleth Plotting with Optional Mechanisms - Version IV), contains the new Carbon-Bond Mechanism-IV (CBM-IV). In addition to containing a new mechanism, the OZIPM-IV expands on earlier versions of the code by providing a wider compatibility between computers, an improved isopleth plotting package, expanded user interaction with control strategy calculations and a new option for determining credits for reductions in carbon monoxide emissions. Volume 1 of the report serves as the User's Manual for OZIPM-IV. Volume 2 contains the listing of the FORTRAN computer code.

52090 **(SNV—3230) PMK program for the measurement of trace metals in wet deposition.** Ross, H. (Stockholm Univ. (Sweden). Dept. of Meteorology). (National Swedish Environmental Protection Board, Solna). 1986. 23p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754436/JAW.

The purpose of this program is to determine the wet deposition of Cd, Cu, Fe, Mn, Pb, and Zn in Sweden, and to correlate wet deposition fluxes of these metals to their concentration in

mosses. Trace metal concentrations are determined using graphite furnace atomic absorption spectroscopy (GFAAS). Procedures which we have initiated to avoid sample contamination are similar to those developed for the determination of trace metals in atmospheric precipitation in Antarctica and in remote areas in the Pacific Ocean. Atmospheric precipitation is collected on a monthly basis in bulk collectors (acid washed) at five PMK rain chemistry stations. At each station there are three collectors. Rain collectors are of funnel and bottle type and are constructed out of conventional polyethylene. Collectors are placed 1 m from the ground and in open fields, at least 10 m from nearest tree. The maximum distance between collectors does not exceed 40 m. Sampling locations are at least 500 m from the nearest road and 200 m from the nearest building. In 1985 highest metal concentrations were found in southern Sweden, concentrations decreased northward. Similar results were seen in 1984.

52091 **(SNV—3243) Environmental impacts of chemical substances. An instruction for preliminary judgement. Final report no. 1 in project field ESTHER.** Landner, L. (National Swedish Environmental Protection Board, Solna). Jan 1987. 97p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754437/JAW.

Part 1 comprises introductory considerations and discusses i.a. the need and applications of uniform criteria for environmental harmfulness of chemical compounds. Also some basic definitions are given. More important international activities are described, and contents and extent of the environment hazards analysis is presented. Part 2 gives i.a. detailed directions to exposure related information that is relevant to the exposure potential of a substance. Advice is given of how to retrieve information and which literature sources that is to be recommended. Information is also given regarding chemical substances to be used to judge the effectpotential in aquatic ecosystems, in biological treatment systems and visavi top consumers.

52092 **(SNV—3265) Mercury. Occurrence and turnover of mercury in the environment. Progress report November 1986.** Lindqvist, O.; Johansson, K.; Timm, B. (National Swedish Environmental Protection Board, Solna). Nov 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754438/JAW.

In 1984, the National Swedish Environmental Board and certain branches of industry initiated a joint research project on the occurrence and turnover of mercury in the environment. During the fiscal years 1984/85 through 1988/89 research will be conducted in the following fields: 1. Swedish emissions of mercury to the atmosphere. 2. Mercury in air. Sources, atmospheric transport and deposition. 3. Occurrence and turnover of mercury in terrestrial systems. 4. Occurrence and turnover of mercury in aquatic systems. The project intends to; - explain why the mercury content in fish in Swedish forest lakes is high now compared with estimated levels in the 19th century, - propose countermeasures that can be taken to reduce the mercury content in fish. This report gives an overview of the research and summarizes the results obtained so far.(authors).

52093 **(STEV-FBT—88-16) Emission of N/sub 2/O, CO, CH/sub 4/, COS and CS/sub 2/ from stationary combustion sources.** Dahlberg, K.; Lindskog, A.; Steen, B. (Swedish Environmental Research Inst., Goeteborg). (Statens Energiverk, Stockholm (Sweden)). 10 May 1988. 25p. NTIS (US Sales Only), PC A03. Order Number DE88754446/JAW.

The investigation included seventeen combustion plants, representing different dimensions and burning techniques. The fuels used were oil, coal, pulverized coal, natural gas, wood chips, peat, firewood and black liquor. Concerning the N/sub 2/O emission no significant differences could be observed for the various fuels. However, the emission seemed to depend on the type of combustion technique. The emissions of N/sub 2/O from coal and peat combustion in fluidized beds were about 100 ppmv (ca 70 mg/MJ) and 50 ppmv (ca 35 mg/MJ), respectively. The larger oil-fired incineration plants emitted approximately 30 ppmv N/sub 2/O (ca 15 mg/MJ). For the other plants investigated the concentrations of N/sub 2/O in the flue gases were less than 10 ppmv (ca 5 mg/MJ). It should be noted that the amounts of N/sub 2/O relative to the energy output are based on rough estimations. The emissions of CO and methane were less than 200 and 5 ppmv, respectively, except for combustion of wood chips and firewood, where the values were much higher (CO sometimes exceeding 2000 ppmv, methane 300 ppmv). The COS concentration did not exceed 100 ppbv. CS/sub 2/, ethane and propane concentrations were, in most of the cases, under the limit of detection. (authors).

52094 **(UCRL—97981) A two dimensional modeling study of the sensitivity of ozone to radiative flux uncertainties.** Grant, K.E.; Wuebbles, D.J. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 4p. (CONF-8808102—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015434/JAW.

From International Quadrennial ozone symposium; Gottingen, F.R. Germany (8 Aug 1988).

Radiative processes strongly effect equilibrium trace gas concentrations both directly, through photolysis reactions, and indirectly through temperature and transport processes. We have used the LLNL 2-D chemical-radiative-transport model to investigate the net sensitivity of equilibrium ozone concentrations to several changes in radiative forcing. Doubling CO_2 from 300 ppmv to 600 ppmv resulted in a temperature decrease of 5 K to 8 K in the middle stratosphere along with an 8% to 16% increase in ozone in the same region. Replacing our usual shortwave scattering algorithms with a simplified Rayleigh algorithm led to a 1% to 2% increase in ozone in the lower stratosphere. Finally, modifying our normal CO_2 cooling rates by corrections derived from line-by-line calculations resulted in several regions of heating and cooling. We observed temperature changes on the order of 1 K to 1.5 K with corresponding changes of 0.5% to 1.5% in O_3. Our results for doubled CO_2 compare favorably with those by other authors. Results for our two perturbation scenarios stress the need for accurately modeling radiative processes while confirming the general validity of current models. 15 refs., 5 figs.

52095 **(UCRL—98088) A two-dimensional model study of past trends in global ozone.** Wuebbles, D.J.; Kinnison, D.E. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 4p. (CONF-8808102—3). NTIS, PC A02. Order Number DE88015432/JAW.

From International Quadrennial ozone symposium; Gottingen, F.R. Germany (8 Aug 1988).

Emissions and atmospheric concentrations of several trace gases important to atmospheric chemistry are known to have increased substantially over recent decades. Solar flux variations and the atmospheric nuclear test series are also likely to have affected stratospheric ozone. In this study, the LLNL two-dimensional chemical-radiative-transport model of the troposphere and stratosphere has been applied to an analysis of the effects that these natural and anthropogenic influences may have had on global ozone concentrations over the last three decades. In general, model determined species distributions and the derived ozone trends agree well with published analyses of land-based and satellite-based observations. Also, the total ozone and ozone distribution trends derived from CFC and other trace gas effects have a different response with latitude than the derived trends from solar flux variations, thus providing a "signature" for anthropogenic effects on ozone. 24 refs., 5 figs.

52096 **(UCRL—99245) Using the {phi}resund experimental data to evaluate the ARAC emergency response models.** Gudiksen, P.H.; Gryning, S.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1988. Contract W-7405-ENG-48. 11p. (CONF-880927—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015430/JAW.

From 17. NATO/CCMS international technical meeting on air pollution modelling and its application; Cambridge, UK (19 Sep 1988).

A series of meteorological and tracer experiments, was conducted during May and June 1984 over the 20-km wide {O}resund strait between Denmark and Sweden for the purpose of studying atmospheric dispersion processes over cold water and warm land surfaces and providing the data needed to evaluate meso-scale models in a coastal environment. In concert with these objectives the data from these experiments have been used as part of a continuing effort to evaluate the capability of the three-dimensional

MATHEW/ADPIC (M/A) atmospheric dispersion models to simulate pollutant transport and diffusion characteristics of the atmospheric during a wide variety of meteorological conditions. Since previous studies have focused primarily on M/A model evaluations over rolling and complex terrain at inland sites, the {O}resund experiments provide a unique opportunity to evaluate the models in a coastal environment. The M/A models are used by the Atmospheric Release Advisory Capability (ARAC), developed by the Lawrence Livermore National Laboratory, for performing real-time assessments of the environmental consequences of potential or actual releases of radioactivity into the atmosphere. These assessments include estimation of radiation doses to nearby population centers and of the extent of surface contamination. Model evaluations, using field experimental data such as those generated by the {O}resund experiments, serve as a basis for providing emergency response managers with estimated of the uncertainties associated with accident consequence assessments. This report provides a brief description of the {O}resund experiments, the current understanding of the meteorological processes governing pollutant dispersion over the {O}resund strait, and the results of the M/A model simulations of these experiments. 11 refs., 7 figs., 1 tab.

52097 **(UCRL—99348) The evaluation of emergency response trace gas and dense gas dispersion models.** Dickerson, M.H.; Ermak, D.L. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 49p. (CONF-8809120—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015447/JAW.

From American Meteorological Society topical meeting; Charleston, SC, USA (25 Sep 1988).

The evaluation of atmospheric dispersion models has been an active concern of the atmospheric science community for the past two decades. During this period, investigators were principally interested in how well an air quality model simulated the dispersion of trace gas emission. Interest in the evaluation of heavier-than-air vapor dispersion models is a more recent development. A variety of statistical techniques and other measures for assessing the performance of air quality models have been proposed. This paper presents a review of these methods, which have been met with both acceptance and criticism within the scientific community, and proposes additional methodologies, especially geared toward the evaluation of real-time accident response models. Since the emergency response manager (ERM) is the one who uses the assessment generated by these models, the major focus of the ideas discussed in this paper revolved around the needs and requirements of the ERM. 35 refs., 19 figs., 5 tabs.

52098 **Correlation of HPLC retention data of triazines with the inhibition of DHFR from L1210 cells: Development of new chromatographic adsorption parameter in QSAR.** Valko, K.; Fellegvari, I.; Katti, A.; Otvos, L. (Central Research Institute for Chemistry, Hungarian Academy of Sciences, P.O. Box 17, Budapest (HU)). *Journal of Liquid Chromatography;* **11**: No. 4, 833-848(1988).

The use of chromatographic retention measurements for quantitative structure-activity relationships (QSAR) was investigated by the development of an adjusted logarithmic retention factor. Retention data of 15 triazine derivatives, which inhibit dihydrofolate reductase were measured by HPLC on octyl-silica and silica gel columns. From these data two parameters were calculated. First, the intercept of the plot of the logarithmic retention factor versus acetonitrile concentration was calculated from the reversed-phase retention measurements (log k'o) and, second, the difference between the logarithmic retention factor at high ammonium salt concentration and low ammonium salt concentration in the mobile phase was calculated from retention measurements on the silica gel column. The first parameter represents hydrophobic properties and the second parameter characterizes adsorption properties of the triazine derivatives. The results show a correlation between the two above mentioned parameters and the inhibition of L1210/71 cell growth.

52099 **Historical and future emissions of acidic deposition precursors from man-made sources.** Placet, M.; Streets, D.G. (Argonne National Lab., IL (USA)). pp 185-188 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Three pollutants - sulfur dioxide (SO_2), nitrogen oxides (NO/sub x/) and volatile organic compounds (VOC) - have been targeted as the primary species involved in the atmospheric chemical reactions that produce acidic deposition. This paper will review estimates of current and historical emissions and analyze projections of future emissions of these pollutants. Historical changes in emission levels can be used in the investigation of long-term trends in precipitation acidity, dry deposition, air quality, and cumulative effects on forests, aquatic systems, and agricultural and material resources. Projections of future emissions aid in the assessment of the possible future intensity and geographical distribution of acidic deposition that might occur in the absence of additional control measures and in the analysis of the effectiveness and costs of possible new measures to reduce emissions.

52100 **Potential changes in transboundary pollutant fluxes associated with scenarios of future emissions.** Shannon, J.D.; Streets, D.G.; Veselka, T.D. (Argonne National Lab., IL (USA)). pp 189-190 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

Much of the acid rain debate between the US and Canada has centered on the extent of damage caused by emissions from the US to sensitive ecological regions of Canada. This issue has also permeated deliberations of the US Congress concerning the need for an emission reduction program. What effect would reducing US emissions have on ecological damage in the US and Canada? Although information is not yet available to reliably estimate damages to certain receptors, changes in deposition can, with appropriate caveats, be estimated with available models of long-range atmospheric transport, transformation, and deposition. Most modeling studies of long-range transport have emphasized the deposition patterns in sensitive areas associated with various source regions. Several recent legal proceedings, however, have focused on the issues of net transboundary mass fluxes of pollutants. In this paper, the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model is used to estimate possible changes in the flux of sulfur species from the US to Canada. Several scenarios of future US emissions of sulfur dioxide are considered. The interannual, climatologically induced variability of transboundary fluxes is also addressed.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 50798, 50845, 51211, 51224, 51229, 51230, 51231, 51232, 51254, 51505, 51978, 52023, 52064, 52142

52101 **(BMU—1987-144) Measurement of gaseous and aerosol-borne radioactivity in the atmosphere.** Postendoerfer, J.; Reineking, A. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Goettingen Univ. (Germany, F.R.). Zentrales Isotopen-Lab. fuer Biologische und Medizinische Forschung). Sep 1986. 95p. (In German). GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The activity/size distribution of artificial radioactive aerosols from nuclear facilities are characterized - besides attachment processes (median 100-500 nm) - by dispersion and resuspension processes leading to a second peak within the size range of 1-6 μm (aerodynamic particle diameter). These processes can be observed in particular with activation products (e.g. Co-60, Zn-65), whereas gaseous fission products (e.g. I-131, Cs-137) attach to the suspended particles of the atmosphere predominantly by heterogenous conden-

sation. The size distribution of aerosols with the short-lived radon decay products RaA (Po-218), RaB (Pb-214) and RaC/RaC' (Bi-214/Po-214) and the radon-220 decay product ThB (Pb-212) were analyzed within closed rooms, with special consideration given to the influence of additional aerosol sources. Aerosol particles, formed by heterogeneous condensation (attachment), show medians (aerodynamic diameter) of about 200 nm, whereas the medians of unattached particle activity of the RaA distributions (free atoms, clustering) are in the diameter range of 1 nm. The free or unattached RaA proportion of activity is mainly determined by the aerosol particle concentration and amounts to about 30% in closed rooms without additional aerosol sources. In long-term measurements in the external atmosphere, the activity/size distribution of the natural radionuclides Pb-210 and Be-7 was determined. Compared to the short-lived radon decay products, here the influence of coagulation processes can be observed which lead to high medians of 600-700 nm. The effect of coal combustion - strong enrichment of the fly ashes with Pb-210 - on the natural size distribution of Pb-210 was analyzed in waste air plumes of coal-fired power stations.

52102 (CONF-760202—, pp 462-467) **Production of radioactive gases in air by medium energy charged-particle beams.** Jacobi, L.R. Jr.; Neff, R.D. (Houston Lighting and Power Co., TX (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

An investigation was conducted to determine the qualitative and the quantitative properties of the radioactivity produced in air by charged-particle beams from the Texas A&M University Cyclotron. Beams of protons (12.5 and 22.5 MeV), alphas (40 and 100 MeV), deuterons (50 MeV) and heavy ions (70 MeV Boron-10) were passed through a thin Vanadium foil at the end of beamline 4 into the cave air. Air sampling through a calibrated chamber utilizing a 3" x 3" NaI crystal showed the significant activities to be ^{13}N, ^{15}O, ^{11}C, and ^{18}F. No isotopes of Argon were detected. Absolute concentrations of the isotopes ranged from 1.3×10^{-5} $\mu Ci/cm^3/\mu A$ following the ^{10}B irradiation to 2.8×10^{-4} $\mu Ci/cm^3/\mu A$ after the deuteron irradiation. These measurements allowed the Cyclotron Institute health physicist to recommend appropriate safety precautions to be initiated following inadvertant irradiation of the air.

52103 (CONF-760202—, pp 693-700) **Statistical distributions as applied to environmental surveillance data.** Speer, D.R.; Waite, D.A. (Pacific Northwest Labs., Richland, WA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Application of normal, lognormal, and Weibull distributions to radiological environmental surveillance data was investigated for approximately 300 nuclide-medium-year-location combinations. The fit of data to distributions was compared through probability plotting (special graph paper provides a visual check) and W test calculations. Results show that 25% of the data fit the normal distribution, 50% fit the lognormal, and 90% fit the Weibull.Demonstration of how to plot each distribution shows that normal and lognormal distributions are comparatively easy to use while Weibull distribution is complicated and difficult to use. Although current practice is to use normal distribution statistics, normal fit the least number of data groups considered in this study.

52104 (CONF-760202—, pp 716-721) **Ambient environmental radiation monitoring at the Lawrence Livermore Laboratory.** Lindeken, C.L.; White, J.H.; Toy, A.J.; Sundbeck, C.W. (Univ. of California, Livermore (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Thermoluminescence dosimetry is the principal means of measuring ambient gamma radiation at the Lawrence Livermore Laboratory. These dosimeters are used at 12 perimeter locations and 41 locations in the off-site vicinity of the Laboratory, and are exchanged quarterly. Control dosimeters are stored in a 75-mm-thick lead shield located out-of-doors to duplicate temperature cycling of field dosimeters. Effect of dosimeters response to radiation in the shield is determined each quarter. Calibration irradiations are made midway through the exposure cycle to compensate for signal fading. Terrestrial exposure rates calculated from the activities of naturally occurring uranium, thorium, and potassium, in Livermore Valley soils vary from 3 to 7 $\mu R/hr$. Local inferred exposure rates from cosmic radiation are approximately 4 $\mu R/hr$. TLD measurements are in good agreement with these data. Off-site and site perimeter data are compared, and differences related to Laboratory operations are discussed.

52105 (CONF-760202—, pp 727-729) **Comparison of gamma-ray exposure rate measurements at Bikini atoll.** Gudiksen, P.H.; Crites, T.R. (Univ. of California, Livermore (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A radiological survey of Bikini and Eneu Islands of the Bikini Atoll was conducted during June 1975 to assess the potential radiation doses that may be received by the returning Bikinians. Bikini Atoll was one of the US nuclear weapons testing sites in the Pacific. An integral part of the survey included measurements of the gamma-ray exposure rates at 1 m above the ground with portable NaI instruments at nearly 2700 locations on the two islands. For comparison purposes, similar measurements were made with a pressurized ion chamber at approximately 200 locations, and with LiF and CaF_2:Dy thermoluminescent dosimeters (TLDs) at 80 locations. The results indicate that the NaI scintillators overresponded because of their nonlinear energy characteristics. The responses of the LiF dosimeters and the pressurized ion chamber agreed to within 13%. Attenuation studies with LiF TLDs indicated that roughly 25% of the total free air exposure rate at 1 m was due to beta radiation.

52106 (CONF-760202—, pp 64-73) **Atmospheric transport of volatile and gaseous radioactive effluents from the PRNC-TRIGA reactor.** Gileadi, A.E.; Perez, R. (Univ. of Puerto Rico, Mayaguez). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A computer code has been developed to evaluate certain radiological hazards associated with the discharge of gaseous and volatile radioactive effluents from the Puerto Rico Nuclear Center TRIGA-FLIP research reactor, using actual operating parameters and executed on the PDP-10 computer of the University of Puerto Rico, Mayaguez Campus. Based on the mathematical model of the generalized Gaussian plume, the code calculates the concentration of any isotope of interest at any position from the source, using such input parameters as position coordinates, source intensity as well as the climatologic data describing the prevailing weather condition. Allowance is made for effective stack height, reflection at the ground surface, and depletion by ground deposition and radioactive decay. The model is tested for accuracy by comparing estimated concentrations with available diffusion data. Depending upon the user's specification, the code uses the finite or the infinite-cloud model to assess the radiological consequences resulting from the emission of gaseous and/or volatile activation products in the case of normal operating conditions, as well as those resulting from the emission of gaseous and/or volatile fission products in the case of fuel cladding failure. Results derived from this study indicate that the hazards related to the emission of gaseous and volatile radioactive effluents from the TRIGA-FLIP reactor are below the permissible values regulated by law.

52107 **(EML—515) Worldwide deposition of ^{90}Sr through 1985.** Juzdan, Z.R. (Department of Energy, New York (USA). Environmental Measurements Lab.). Jun 1988. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015577/JAW.

The total deposition of ^{90}Sr on the surface of the earth during 1985 was 0.2 PBq, with approximately equal amounts deposited in the Northern and Southern Hemispheres. This is the lowest total deposit since the initiation of the global fallout program of the Environmental Measurements Laboratory in the mid-1950's. The

cumulative deposit of ^{90}Sr decreased to 264 PBq in the Northern Hemisphere and 85 PBq in the Southern Hemisphere, making a worldwide cumulative deposit of 349 PBq (9.4 MCi). 25 refs.

52108 (IFE/KR/E—87/002) **Filtering effect of buildings on airborne particulate matter.** Christensen, G.C.; Mustonen, R. (Institutt for Energiteknikk, Kjeller (Norway); Finnish Centre for Radiation and Nuclear Safety, Helsinki). (Institute for Energy Technology, Kjeller (Norway)). Oct 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754474/JAW.

Within the radioecological programme of the Nordic Liaison Committee for Atomic Energy (NKA), the possible consequences of a major reactor accident are one of its main research branches. This study of the filtering effect of buildings on airborne particulate matter has been one part of this branch. The absorbed dose to a person from a passing radioactive cloud will be lower if he has been indoors and not ourdoors during the cloud passage. The aim of this study has been to find filtering factors for typical Finnish and Norwegian houses to use in model work.

52109 (INIS-mf—11261, pp 3-7) **Permissible radionuclide concentrations in atmosphere.** Gusev, N.G.; Belyaev, V.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The permissible radionuclide concentrations in atmosphere are presented that have been calculated on the basis of the permissible dose commitments for population established in the USSR according to the 'Sanitary rules of NPP designing and operating', SP-AEhS-79. The exposure from air admixtures, fall-outs on the soil, due to inhalation and through the food chains was taken into account. The irradiation through the food chains was calculated on the basis of an original technique that took into consideration the intakes with meat, milk, bread, vegetables and fruits. 4 refs.; 1 tab.

52110 (INIS-mf—11261, pp 8-12) **Study of near-ground radionuclide concentration distribution in the Ignalina NPP district.** Yasyulenis, R.Yu.; Krenyavichus, R.I.; Serapinas, A.A.; Morkelyunas, Yu.-L.Yu.; Miloshene, L.V. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

In the course of nuclear weapon testing a great amount of fission products has been released into the atmosphere, thus the long-living radionuclides are still present there contributing to the radiation conditions near the NPP. Often the concentrations of radionuclides released during the reactor operation are comparable with the global background levels. The latter were studied in Ignalina NPP district since 1978. Sampling was done via air pumping through filters at 2000 m/sup 3//h rate. The sample gamma activity after filter incineration was determined with the use of spectrometer with Ge(Li) semiconductor detector. Time dependence of beryllium-7 and caesium-137 concentrations over period of three years has been obtained. The evaluations of radionuclide concentration distributions connected with the NPP releases show substantial difference from the background concentrations. 4 refs.; 4 figs.

52111 (INIS-mf—11261, pp 13-17) **Draft of a unified evaluation technique of radioactivity spreading from NPPs for CMEA member-countries.** Shtubnya, M.; Khorvat, D.; Shkulets, Sh.; Namestek, L.; Kunz, Eh.; Kovalevich, O.M.; Chebotarev, V.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Basic principles of a unified evaluation technique of radioactivity spreading from NPPs under normal and accidental conditions and population dose commitment calculations are presented. These principles are included into a draft of a scientific-technical document prepared within the scope of the international Interatomenergo programme. The calculation technique takes into consideration the major irradiation paths and radioactivity intakes and includes formulae and parameters needed for practical determining the individual and collective dose rates due to radioactivity releases to the atmosphere and water. The method is based on the chamber model with the use of concentration and transport factors between the separate block-chambers. 1 fig.

52112 (INIS-mf—11261, pp 53-59) **Forecast of airborn radionuclide distribution near NPP.** Belov, A.P.; Krenyavichus, R.I.; Yasyulenis, R.Yu.; Vasil'kovas, A.L. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

To evaluate the distribution of airborn radionuclides getting into the atmosphere in different chemical forms a solution of diffusion equations set has been obtained with regard to radioactive decay and chemical transformations. The average concentrations of the considered radionuclides were determined taking into account the wind velocity and direction distributions as well as the average values of turbulence coefficients. The calculation of HTO distribution has been carried out for a 100km zone around the source with the use of a parameter set obtained by processing the meteorological data collected near the source. Types of the near-ground air layer stability were identified by Pasquill's method. The radionuclide distributions were calculated on the basis of the available data on the release rates and forms. Concentrations of radioactive carbon in the air are given for a region where RBMK-1000 reactor is located. 5 refs.; 3 figs.; 1 tab.

52113 (INIS-mf—11261, pp 60-66) **Background radioactivity variations in near-ground air.** Luyanas, V.Yu.; Zaharova, G.A.; Zinkyavichyus, P.K. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The results of a background radioactivity study in the region of Ignalina NPP construction are presented including data on concentrations of a number of artificial and natural radionuclides in the near-ground air and fallouts that were collected in Vil'nyus within two desades, since 1961 up to 1981. Variations of Cs-137, Zr-95+Nb-95, Na-22, Ba-140+La-140, P-32 and Be-7 concentrations have been investigated. Using the curves of maximum concentration variations the times of radionuclide half-life in the atmosphere have been calculated. For Na-22 and Cs-137 they were 11.9 and 6.2 months respectively. 3 refs.; 5 tabs.; 3 figs.

52114 (INIS-mf—11261, pp 120-126) **Atmosphere contamination in the vicinity of Obninsk NPP.** Makhon'ko, K.P.; Martynenko, V.P.; Rabotnova, F.A.; Silant'ev, A.N.; Volokitin, A.A.; Shkuratova, I.G. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The results of permanent observations of the atmosphere contamination are presented for 12 points in Obninsk and the surrounding region within 10km from Obninsk NPP. The total beta-activity and isotopic composition were determined on radioactive aerosol samples as well as Cs-137 content in the soil near the NPP. The atmosphere contamination levels and aerosol isotopic compositions have been compared with those obtained in other regions where only the global contamination exists. Obninsk NPP releases were shown to produce no appriciable contamination of the atmosphere and soil in the town and its vicinity. 6 refs.; 4 figs.

52115 (INIS-mf—11261, pp 155-159) **I-129 background concentration dynamics and identification technique.** Styro, B.I.; Nedvetskajte, T.N.; Filistovich, V.I. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

An attempt has been made to develop a global model for determining I-129 distribution on the basis of concentration measur-

ings, with regard to its production and output from natural sources (spontaneous decay of uranium and thorium, production due to cosmic rays) and artificial sources (power reactors, nuclear tests within 1945-1962). A method is described for I-129 background concentration measuring in samples of air/water from the environment or biological objects, with activation analysis application. 12 refs.; 4 figs.

52116 **(INIS-mf—11696) Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.** Hosemann, G.; Wirth, E. (eds.). (Universitaetsbund Erlangen-Nuernberg e.V., Erlangen (Germany, F.R.); Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Universitaetsbibliothek). 1987. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

Several authors analyse the processes, which occurred during and after the reactor accident at Chernobyl. Interactions and correlations are explained in a way easy to understand. In addition, other authors deal with issues of exposure to natural radiation from the earth's crust, from the atmosphere and outer space, and with their impacts on living organisms. In conclusion, one author evaluates the reactor accident and its consequences for society from the churches' point of view. 8 abstracts were entered separately into the data base.

52117 **(NUREG—0837-Vol.8-No.1) NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January-March 1988.** Struckmeyer, R.; McNamara, N. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). Jun 1988. 222p. NTIS, PC A10/MF A01 - GPO. Order Number TI88012788/JAW.

This report provides the status and results of the NRC Thermoluminescent Dosimeter (TLD) Direct Radiation Monitoring Network. It presents the radiation levels measured in the vicinity of NRC licensed facility sites throughout the country for the first quarter of 1988.

52118 **(ORNL/M—532) Environmental surveillance data report for the first quarter of 1988.** Blasing, T.J.; Daniels, K.L.; Goldberg, P.Y.; Horwedel, B.M.; McCollough, I.L.; Osbourne-Lee, A.E.; Valentine, C.K.; Wolf, D.A. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88015707/JAW.

The Environmental Monitoring and Compliance (EMC) Department within the Environmental and Health Protection Division (EHP) at the Oak Ridge National Laboratory (ORNL) is responsible for environmental surveillance to: (1) assure compliance with all Federal, State, and DOE requirements for the prevention, control, and abatement of environmental pollution, (2) monitor the adequacy of containment and effluent controls, and (3) assess impacts of releases from ORNL facilities on the environment. To meet these objectives, the EMC Department has implemented a surveillance program that consists of both monitoring and sampling of environmental constituents. The surveillance program for 1988 includes sampling and monitoring of air, water from surface streams and point sources, fish, milk, soil, and vegetation (grass) for radioactive and nonradioactive materials. This report includes data for air, surface water, and milk. Surveillance points are located on-site to quantify discharges from ORNL facilities, and off-site to determine public exposures and to establish background reference levels. The purpose of this report is to provide Laboratory and Central Management personnel with the most recent information on environmental conditions. 1 ref., 15 figs., 44 tabs.

52119 **(PTB-Ra—21) Radionuclide concentration in ground-level air from 1986 to 1987 in North Germany and North Norway.** Kolb, W. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Radioaktivitaet). Mar 1988. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754676/JAW.

The activity concentration of various fission products and some other radionuclides (e.g. Be-7, Na-22, K-40 and Pb-210) contained in surface air were determined by γ-spectroscopy. The mean monthly acitvity concentrations of up to 30 radionuclides measured in 1986 and 1987 in Brunswick, Berlin and Skibotn (North Norway) are tabulated. The Chernobyl accident of April 26, 1986, resulted in 1986 in an annual mean Cs-137 activity concentration of 2.4 mBq/m/sup 3/ in Brunswick, 8.8 mBq/m/sup 3/ in Berlin and 0.3 mBq/m/sup 3/ at Skibotn. In 1987 the Cs-137 concentrations were just about 1% of these values. Occasionally fresh fission products from other sources were detected as e.g. I-131 in March 1987 (very likely released from a reactor site in Ukraine) and in August 1987 (released from an underground nuclear test on Novaja Zemlya together with other short-lived fission products). The effective dose equivalent due to inhalation of fission products is estimated for all three sites and compared with the Pb-210 inhalation dose.

52120 **(SIS—1988:1) Recommended action levels for radon in dwellings. Recommendations from the committee "Radon in dwellings".** (Statens Inst. for Straalehygiene, Oslo (Norway)). 1988. 13p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754492/JAW.

The recommendation made by a group appointed by the Directorate of Public Health, arrives at the conclusion that radon in Norwegian dwellings implies a substantial health problem for the country. For this reason it is recommended that actions should be taken to reduce the radiation exposure from radon in Norway. Upper levels for such actions are set to 200 Bq/m/sup 3/ (radon in air of dwellings) for new contructions. For existing dwellings having concentrations of 200 - 800 Bq/m/sup 3/, simple and unexpensive remedial actions to reduce levels are sufficient. When levels exceed 800 Bq/m/sup 3/, more elaborate and costly actions are necessary. An evaluation of the extent of the radon problem in Norway is included, together with a survey of the cost and benefit involved in choosing various levels for remedial actions.

52121 **(SIS—1988:3) Lung cancer risk by indoor exposure to radon.** Sanner, T.; Dybing, E.; Stranden, E. (Norske Radiumhospital, Oslo; Statens Inst. for Folkehelse, Oslo (Norway); Statens Inst. for Straalehygiene, Oslo (Norway)). (Statens Inst. for Straalehygiene, Oslo (Norway)). 1988. 73p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754493/JAW.

The National Institute of Radiation Hygiene has performed radon measurements in about 1500 homes (blocks of flats excluded). In each dwelling measurements were made for equal time periods in the living room and in one of the bedrooms. All measurements were made during the heating season. The mean concentration of radon during the summer was about 50% of the mean concentration in the winter. This implies that the average annual level is about 75% of the level in the heating season. Based on these measurements it was calculated that the average level of radon decay products is 55 Bq/m/sup 3/ EER (Equlibrium Equivalent Radon) in dwellings located on the ground floor and/or ground floor and first floor; and 18 Bq/m/sup 3/ EER in appartments on the first floor. It was estimated that in dwellings on the ground floor and/or ground floor and first floor, about 10% of the dwellings have levels of radon decay products above 100 Bq/m/sup 3/ EER, 3% levels above 200 Bq/m/sup 3/ EER and 1% levels above 400 Bq/m/sup 3/ EER. Approximately 3 million Norwegians are living in dwellings located on the ground floor and/or ground floor and first floor (estimaed dose due to radon: 2.8 mSv/year), while about 400.000 are living in appartments on the first floor (estimated dose due to radon: 1.0 mSv/year). Based on the WHO risk factors it was calculated that in Norway approximately 120 - 360 cases of lung cancer deaths per year are due primarily to indoor exposure to radon and its decay products. This corresponds to about 10 - 30% of all lung cancer deaths in Norway. Summary in English; 80 refs.

52122 **(TVA/PUB—88/7) Watts Bar Nuclear Plant annual radiological environmental monitoring report, 1987.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). May 1988. 116p. NTIS, PC A06/MF A01. Order Number DE88016072/JAW.

This report describes the preoperational environmental radiological monitoring program conducted by TVA in the vicinity of

the Watts Bar Nuclear Plant (WBN) in 1987. the program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Material sampled includes air, water, milk, foods, vegetation, soil, fish, sediment, and direct radiation levels. The exposures calculated from environmental samples were contributed by naturally occurring radioactive materials, from materials commonly found in the environment as a result of atmospheric fallout, or from the operation of other nuclear facilities in the area. Since WBN has not operated, there has been no contribution of radioactivity from the plant to the environment. 4 refs., 2 figs., 1 tab.

52123 **(TVA/PUB—88/11) Annual radiological environmental operating report: Sequoyah Nuclear Plant, 1987.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). Apr 1988. 121p. NTIS, PC A06/MF A01. Order Number DE88016081/JAW.

This report describes the environmental radiological monitoring program conducted by TVA in the vicinity of the Sequoyah Nuclear Plant in 1987. The program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Samples are taken from stations in the general area of the plant and from areas not influenced by plant operations. Station locations are selected after careful consideration of the weather patterns and projected radiation doses to the various areas around the plant. Material sampled includes air, water, milk, foods, vegetation, soil, fish, sediment, and direct radiation levels. Results from stations near the plant are compared with concentrations from control stations and with preoperational measurements to determine potential impacts of plant operations. 2 figs., 2 tabs.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 52056, 52069, 52099

5006 Regulations

52124 **(SNV—3049) Air pollution - Vegetation damage. Influence of gaseous impurities on vegetation, in particular photochemical effects.** Skaerby, L. (IVL, Goeteborg (Sweden)). (National Swedish Environmental Protection Board, Solna). Oct 1985. 49p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754421/JAW.

The report is a summing-up of present knowledge in the field. Today ozone is considered the most harmful photochemical oxidizing agent creating damage to vegetation. Ozone is poisonous in percentages comparable to the presently accepted background levels. The vegetational effects of ozone are strongly increased when simultaneously enlarged contents of NO/sub 2/ and SO/sub 2/ exist. In the light of these facts the following limits of ozone are recommended for Sweden: 120 micrograms/cubic meter 1h/season 80 micrograms/cubic meter mean value for season (May-Sep). With 76 refs.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 52054

5101 Basic Studies

REFER ALSO TO CITATION(S) 50973, 51798, 51933, 52148

52125 **(INIS-BR—1240) Utilization of atmospheric C-14 as tracer of soil organic matters.** Lobo, P.F.S. (Bahia Univ., Salvador (Brazil)). 1972. 54p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704127/JAW.

Two ferrallitics profiles, of the state of Bahia (Brazil), have been analysed and the /sup 14/C//sup 12/C ratio of about fifteen samples measured (fulvics acids, humics acids, humin, as extracted by Dalbin's method). The amount of soil that comes up to the surface by the action of Lumbricidae has been estimated for one profile by means of radiometric measurements. (M.A.C.).

52126 **(SNV—3163) Top thinning of spruce and pine in the PMK reference sites.** Andersson, B. (National Swedish Environmental Protection Board, Uppsala). Jun 1986. 22p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754430/JAW.

Top thinning occurs in all regions particularly at higher sites. Spruce is considerably more sensitive than pine. Top thinning should be related to i.a. climate, topography and blend of tree varieties. (G.B.).

52127 **(SNV—3182) Choice of varieties of tree. Influence on ground and water. A literature survey aimed mainly at air pollution and soil acidification.** Liljelund, L.E.; Nilsson, I.; Andersson, I. (National Swedish Environmental Protection Board, Solna). Aug 1986. 53p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754433/JAW.

Differences between stands with broadleaved and coniferous trees, respectively, are analyzed regarding soil conditions and soil-water composition. The analysis is made with special reference to air pollutants and soil acidification since there are proposals to increase the proportion of broadleaved trees as a counter-measure against negative effects of air pollutants. The report is solely based on material from literature and ongoing research. The comparisons are made mainly between birch (Betula sp.) and Norway spruce (Picea abies). The general conclusion is that birch has a lesser acidifying effect than coniferous trees on the upper soil layers. By comparisons in pairs between birch and spruce stands the soil is always more acid in the spruce stands. The differences are 0.5-1.0 pH-units in humus and 0.3-0.7 pH-units in the upper mineral soil. The acidifying effect of spruce and pine can be slightly counteracted by an admixture of birch. A share of 50% birch gives 0.2-0.3 units higher pH in the humus in moderate to good site classes. The decomposition and turnover of birch litter in the upper soil layers is of a completely different kind than for needles. This gives better soil conditions in birch stands than in coniferous stands concerning the acid-base status. The deposition of acid compounds is greater below coniferous trees than below broadleaved trees. This is caused by morphological differences between species. Moreover, the differences increase with increasing immisions. However, differences in soil conditions, especially soil pH, was recognized a long time before any deposition effects. (authors). With 51 refs.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 50530, 50832, 50840, 51744, 52064, 52081, 52083, 52091, 52118, 52156, 52162, 52441

52128 **(ANL/EES-TM—350) Environmental effects and fate of decontamination agent C-8 in soil.** Zellmer, S.D.; Mego, W.A.; Hinchman, R.R. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016445/JAW.

Agent C-8 is a new Army decontamination agent designed to deactivate and remove chemical and biological warfare agents from vehicles and equipment. Its active ingredients are tetrachloroethylene (designated as a priority pollutant by the US Environmental Protection Agency) and calcium hypochlorite (a source of free chlorine). This laboratory study focused on the environmental fate of C-8 constituents in the soil ecosystem; the soil transport characteristics of, and potential for groundwater contamination by, tetrachloroethylene; and the effects of C-8 constituents on soil microorganisms. Four scenarios were developed to simulate most actual C-8 spills in the field. Soil columns in glass cylinders simulated the upper portion of a typical soil profile. Effluents and soils from each column were analyzed by gas chromatography to determine tetrachloroethylene concentrations. An identical set of soil samples was screened for effects on various groups of soil microorganisms. When tetrachloroethylene in C-8 enters the soil, it appears to be sorbed in certain profile regions and its movement is retarded

with respect to that of water. This bound tetrachloroethylene appears to leach out of the soil profile over a long time, moving down toward groundwater at concentrations that are low (≃ 10 ppM) compared with those originally applied to or retained in the soil. Effects on soil biota depend on physiological differences among species. Soil fungi appear to be affected most adversely, while some bacterial groups are unaffected by exposure to C-8 and others are enhanced. 13 refs., 17 figs., 5 tabs.

52129 (EPRCF—8601, pp 192-196) **Study on influence of acid rain on the inland environment.** Maekawa, Tsutomu; Tagawa, Takateru; Sawada, Toshinosuke; Hiyoshi, Saburo; Ariga, Osamu. Oct 1986. (In Japanese). Environmental Pollution Research Center of Fukui Prefecture, Fukui, Japan.

In FY 1985 Annual report of the Environmental Pollution Research Center of Fukui Prefecture.

This is a report on the result of survey of major seven rivers, survey on 14 background spots in Fukui Prefecture with less artificial pollution sources, and the survey on the capacity of inland environment for the acid rain measured by alkalinity. Although the pollution research center (Fukui Pref.), already in 1967, observed that the rain water had been acidified, with successive data of annual average of pH of 4.5, pH of inland water has been at the level of 7.5 without any indication of acidification. Degree of alkalinity has also been at the general level of Japan indicating that the function of neutralization is reasonably worked out. In the Tsuruga Peninsula, however, where the neutralizing power is small because of granite soil, pH tends to be rather low; alkalinity of 10 ppm indicates somewhat poor neutralizing ability. Rate of increase of permanent hardness seems to be effective for the prediction of the influence of the acid rain. (5 figs, 2 tabs, 7 refs)

52130 (EPRCF—8601, pp 61-74) **Study on rain water components (Part 5).** Yamada, Toshihiro; Masamichi, Hiroharu; Takada, Toshio; Inazu, Etsuro. Oct 1986. (In Japanese). Environmental Pollution Research Center of Fukui Prefecture, Fukui, Japan.

In FY 1985 Annual report of the Environmental Pollution Research Center of Fukui Prefecture.

In order to grasp the actual condition of rain water and its pH at 12 points in Fukui Prefecture. Range of rain water pH is 3.78 - 5.78; low pH is found in autumn; chlorine ion showed significant fluctuation. Relation between [Δanion] and [H^+] and the ratio (acid ratio) differs by places and seems to represent the characters of the area. Further examination confirmed the existence of a rain water which contains chlorine ion as an acid, which indicated the formation of HCl by the reaction not only of sea-salt, but also of HNO_3 and H_2SO_4. By the comparative study of pH between the air polluting substances and the weather conditions, various conditions for the days of the lowest pH were clarified. (13 figs, 6 tabs, 10 refs)

52131 **(GSF—23/87) EXSOL - modelling of the transport and final distribution of substances in the soil.** Matthies, M.; Behrendt, H.; Muenzer, B. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien). Dec 1987. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754299/JAW.

The EXSOL model describes the transport of a substance applied to the soil surface through a one-dimensional multi-layer model. Each layer consists of three phases (soil matrix, soil water, and soil air), among which the substance is distributed. For each layer equilibrium is assumed to be attained quickly; this process is described by substance-characteristic distribution coefficients. Vertical transfer into adjacent soil layers takes place by advective transport in the watery phase (water flow), diffusive/dispersive transport in the watery phase, and by diffusive transport in the soil air. The uptake of a substance via the roots into the plant is calculated with the aid of concentration factors. For the decomposition (biotic, hydrolytic,...), first-order or pseudo first-order reactions are assumed. A numerical method is used to solve the system of linear differential equations.

52132 (OPRCE—8601, pp 176-179) **Survey on soil regeneration by reutilized resources.** Yamamoto, Jun; Kumajo, Kazuo; Yoshimura, Hiroshi; Hanaoka, Isamu; Kondo, Masahiro. (Okayama Prefectural Research Center of Environment and Public Health, Okayama, Japan). Jul 1986. (In Japanese). Okayama Prefectural Research Center of Environment and Public Health, Okayama, Japan.

In FY 1986 Annual report of Okayama Prefectural Research Center of Environment and Public Health.

What is reported is the heavy metal content and fertilizer content, etc. of city sewage and compost, etc. of 26 points in Okayama Prefecture. Concerning Cd, As, and Hg, there were 2 cases of Hg which somewhat exceeded the component standard of fertilizer regulation; content of other metals fluctuated much in the city sewage. Comparison with the Clark number, Zn was more than ten times; other heavy metals were equal or less. Zn must be investigated for the usability because of the soil contamination criterion when it is to be used for the agricultural application. Incineration treatment decreases the content of Hg, C, N, but increases other elements as Zn, Ni, Cr, Pb, and phosphoric acid. Content of Ca greatly fluctuates according to the use of the treating agents. As for the fertilizer elements, K is less than N. (4 tabs)

52133 **(PNL-SA—15942) Northwest hazardous waste site characteristics under industrial and climatic settings.** Steelman, B.L.; Hartz, K.E.; Woodruff, D.L.; Triplett, M.B. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 16p. (CONF-8805144—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012693/JAW.

From Hazardous waste outlook for the 90's; Spokane, WA, USA (23 May 1988).

The Pacific Northwest Laboratory (PNL) has an effort under way to identify both appropriate existing technology and the need to develop new technology to assess and remediate hazardous waste management problems. This effort has been performed in support of several activities within PNL, including programmatic planning for the Northwest Hazardous Waste Research, Development, and Demonstration Center. Among other interests, we wanted to know if common problems existed across the Northwest region.

52134 **(SNV—3022) Flora and acidification - Effects of SO/sub 2/ and NO/sub x/. Knowledge survey and possible actions in favour of terrestrial vegetation (tracheophytes, mosses, lichens).** Fiskesjoe, A.L.; Ingeloeg, T. (Sveriges Lantbruksuniv., Uppsala (SE). Inst. foer ekologi och miljoevaard). (National Swedish Environmental Protection Board, Solna). Dec 1984. 84p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754418/JAW.

Several direct effects of SO/sub 2/ and NO/sub x/ as well of acute as chronic nature are described in literature. In addition several indirect effects are described e.g. lack of nutrients by leaching basic cations, toxic effects from release of aluminium, and eutrofication from nitrogen. Also other soil processes may be impeded e.g. ground breathing and formation of mycorrhizas. Plant reproduction seems to be particularly sensitive to influence. Despite of a limited basis in Sweden air pollution already constitutes a serious threat to the flora. Lichens and also mosses in the south and middle part of the country are heavily affected by air pollution and several species are in danger. To tracheophytes, particularly herbaceous plants, the nitrogen eutrofication in the same part of the country is a serious and increasing threat. A list is presented of more than 80 tracheophytes, some ten mosses and thirty lichens, where air pollution creates an important risk factor. Various ways to countercheck acidification are discussed. A general decree on liming as a vegetation preserving measure will not be recommended. (G.B.).

52135 **(SNV—3187) Possibility of using lichens as indicators of air pollution and damage to forests.** Westman, L. (Umeaa Univ. (Sweden). Ekologisk botanik). (National Swedish Environmental Protection Board, Solna). Nov 1986. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754434/JAW.

The investigation aims at testing lichens as indicators in studies of air pollution forest damage, particularly by sulfur dioxide. The intention is to compare clumps of trees of various degree of damage in different regions of the country. A comparison is made of the patterns of sulfur content of pine-tree lichen and the theoretically estimated sulfur deposition, the occurrence of four different indicators on spruce, of varying levels of sensitivity, and the frequency of forest damage, (top thinning of spruce). Furthermore, the connection between sulfur content and pH-value of bark from the same tree is examined. In addition to occurrence, also frequency, maximum length and vertical distribution in the top region are examined. Clumps of different localities in the southern part of Sweden are classified according to the occurrence of sensitive species, sulfur content, one year deposition of SO/sub 4/-S, NO/sub 3/-N, NH/sub 4/-N and H/sup +/, and degree of top thinning. On separate trees a comparison is made of the state of dominance, the highest level on the tree and the body lengths of different species growing on spruce of varying degrees of damage (top thinning). In this way the influence of air pollution will be indicated by lichens on a clump level but not on separate trees. (with 33 refs.) (O.S.).

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 50726, 50798, 50806, 50832, 50839, 50840, 50841, 50845, 51265, 51268, 51721, 52023, 52064, 52103, 52117, 52118, 52121, 52122, 52123

52136 **(CEA-CONF—9348) Technical aspects of the french R and D programme devoted to radionuclide migration in the geosphere: a review.** Baudin, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 2p. (CONF-870965—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754785/JAW.

From International conference on chemistry and migration behavior of actinides and fission products in the geosphere; Munich, F.R. Germany (14 Sep 1987).

52137 (CONF-760202—, pp 730-734) **Colorado's plutonium-in-soil standard.** Hazle, A.J.; Crist, B.L. (Colorado Department of Health, Denver CO (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Colorado adopted a plutonium-in-soil standard in 1973. This standard, considered conservative at the time of adoption, was based on the then-identified nature of soil sampling, the then-available ambient air plutonium concentrations associated with contaminated soil and the unknown risk associated with general public exposure to such materials. With the availability of additional information, the standard was re-evaluated and this paper is a summary of that effort.

52138 (CONF-760202—, pp 742-747) **Marshall Islands radiological followup.** Greenhouse, N.A.; McGraw, T.F. (Brookhaven National Lab., Upton, NY (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

In August, 1968, President Johnson announced that the people of Bikini Atoll would be able to return to their homeland. Thereafter, similar approval was given for the return of the peoples of Enewetak. These two regions, which comprised the Pacific Nuclear Testing Areas from 1946 to 1958, will probably be repopulated by the original inhabitants and their families within the next year. As part of its continuing responsibility to insure the pulbic health and safety in connection with the nuclear program under its sponsorship, ERDA (formerly AEC) has contracted Brookhaven National Laboratory to establish radiological safety and environmental monitoring programs for the returning Bikini and Enewetak peoples. These programs are designed to define the external radiation environment, assess radiation doses from internal emitters in the human food chain, make long range predictions of total doses and dose commitments to individuals an to each population group, and to suggest actions which will minimize doses via the more significant pathways.

52139 **(DOE/NV/10503—T1) Uncertainty and sensitivity analyses of simulated concentrations of radionuclides in milk.** Breshears, D.D. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Fal 1987. Contract AC08-86NV10503. 95p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016824/JAW.

The PATHWAY model predicts concentrations of radionuclides in milk and other foods in the southwestern US during the period of atmospheric testing of nuclear weapons in Nevada. Consumption of contaminated milk was one of the most important sources of dose for local residents. This study incorporated variations associated with pasture use by commercial dairy farmers into PATHWAY and examined the effects of these variations on time-integrated concentrations of I-131 and Cs-137 in milk. The uncertainty in estimates of integrated concentrations and the sensitivity of the concentrations to changes in model parameters were studied for two agricultural regimes. Parameter sensitivity was assessed on several scales using various techniques. Influential parameters tend to be associated with the most direct pathway for milk contamination. These include the foliar interception fraction, which determines the initial concentration for pasture; the fraction of a dairy cow's diet obtained from pasture; and the production rate of milk. Variations in the timing of pasture use are important for short-lived radionuclides when a fallout event occurs while cows are going onto or coming off of pasture. 44 refs., 9 figs., 4 tabs.

52140 (INIS-mf—11261, pp 133-138) **Cs-137 migration in soil near NPPs.** Silant'ev, A.N.; Shkuratova, I.G.; Khatskevich, R.N. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A convective-diffusion model has been employed for describing Cs-137 migration in soil. The migration parameters were determined by comparing the calculated vertical distribution profiles with the experimental ones. The migration parameters dependence on the soil state has been studied. Cs-137 penetration rate was found to be function of the soil type, surface state, soil wetness and orography. The obtained values are presented. A method is suggested for revealing the soil surface contamination by Cs-137 produced during NPP operation with distinguishing it from the global contamination background. For this purpose Cs-137 content in the upper 5 mm soil layer is estimated. 4 refs.; 3 tabs.

52141 **(INIS-mf—11261) Radiation safety of Nuclear Power Plants operation. Book 5. Collection of papers from CMEA scientific-engineering conference.** (Sovet Ehkonomicheskoj Vzaimopomoshchi, Moscow (USSR). Postoyannaya Komissiya po Ispol'zovaniyu Atomnoj Ehnergii v Mirnykh Tselyakh). 1984. 189p. (In Russian). (CONF-8205317—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW.

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

A collection of papers presented at the CMEA Scientific-Engineering Conference held in Vilnus, Lithuanian SSR, May 1982. This work concerns radiation safety and environmental impacts of the Soviet Nuclear Power Plants

52142 (INIS-mf—11696, pp 11-20) **Radioactivity and ionizing radiation.** Finckh, E. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Physikalisches Inst.). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

There is no point in making a distinction between natural and artificial radiation. The effect of radiation is to judged along the lines of activity, energy, radiation type, external irradiation and

exposure due to incorporated radioactive substances. The chemical properties of radioactive substances are especially important due to their biological behaviour in the human body and also in the chain soil/water-to-plant-to-animal and their enrichment in organs.

52143 (INIS-mf—11696, pp 25-43) **Exposure to natural radiation from the earth's crust, atmosphere and outer space - the natural radioactivity of the earth's crust.** Schwab, R.G. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Lehrstuhl fuer Geologie und Mineralogie). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

Any conclusions to be drawn from the geochemical distribution pattern of radioactive elements for one's own conduct require to study their distribution in soil, earth crust, magmatic differentiation, rock disintegration zone and biosphere. The author notes that high activities in soils and rocks are contrasted by relatively low radiation dose levels absorbed by the human body. This is different for incorporated radiation.

52144 (TVA/PUB—88/8) **Environmental radioactivity levels, Bellefonte Nuclear Plant: Annual report, 1987.** (Tennessee Valley Authority, Chattanooga (USA). Radiological Control). Jun 1988. 27p. NTIS, PC A03/MF A01. Order Number DE88016077/JAW.

A preoperational environmental radiological monitoring program was implemented in August 1978 and continued through 1983. This program had the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. Because of the extended delay in fuel loading, the sampling program was substantially reduced for 1984 and 1985 with further reductions in 1986. This reduced program will continue until 1 year prior to fuel loading. At that time, the full preoperational sampling program will be restarted. This report presents the results obtained from the program conducted during 1987. 6 figs., 9 tabs.

52145 **Interrelationships among plant biomass, plant surface area and the interception of particulate deposition by grasses.** Pinder, J.E. III; Ciravolo, T.G.; Bowling, J.W. (Savannah River Ecology Lab., Aiken, SC (USA)). *Health Physics;* **55**: No. 1, 51-58(Jul 1988).

The interrelationships among plant biomass, plant surface area and interception fraction were determined for the interception by corn of ^{239}Pu-bearing particles released to the atmosphere from the H-Area nuclear fuels chemical separations facility on the U.S. Department of Energy's Savannah River Plant in Barnwell County, South Carolina. The relationship between interception fraction and corn biomass was accurately approximated by a filtration model with an absorption coefficient of 3.60 m2 kg-1. A filtration model with an absorption coefficient of 2.91 m2 kg-1 accurately approximated the relationship between biomass and interception fraction for data compiled from the literature for a variety of grass species. A linear regression model accurately approximated the relationship between interception fraction and surface area, but was not a better predictor of interception fraction than the filtration model for biomass.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 50525, 50939, 51229, 51230, 51231, 51232

52146 (DOE/EA—0340-Vol.1) **Craig-Bonanza 345-kV Transmission Line Project: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). 1988. 210p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88016377/JAW.

The Department of Energy (DOE), and the Western Area Power Administration (Western) proposes to construct and maintain a 345- kilovolt (kV) transmission line between Craig, Colorado, and Bonanza in eastern Utah. The project began in 1986 and construction is scheduled to be completed in 1989. The project, known as the Craig-Bonanza 345-kV Transmission Line Project (Project), will be located in Moffat and Rio Blanco counties in Colorado and Uintah County in Utah. Western has the lead role for project development and management, including environmental studies and construction. Cooperating federal agencies include the Bureau of Land Management (BLM), Rural Electrification Administration, US Fish and Wildlife Service, and Bureau of Indian Affairs. This environmental assessment was prepared in compliance with the National Environmental Policy Act (NEPA) and the regulations of the Council on Environmental Quality (CEQ), the DOE and the BLM. 360 refs., 33 figs., 21 tabs.

52147 (DOE/EA—0340-Vol.2) **Craig-Bonanza 345-kV transmission line project: Environmental assessment.** (USDOE, Washington, DC). 1988. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88016378/JAW.

Appendix A presents the regional sensitivity criteria and results that were developed for identified alternative transmission line corridors for the Craig-Bonanza 345-kV Transmission Line Project. The sensitivity analysis involved evaluating the sensitivities of the regionally-documented environmental resources to change or conflict from the introduction of a 345-kV transmission line. The environmental sensitivity criteria were based on consideration of two factors: 1) the resource value of the environmental feature within the region; and 2) the susceptibility of the resource to change, modification or stress from the construction, operation and maintenance of the Project. Four levels of sensitivity were used by the resource specialists: Maximum, Major, Moderate and Minimal Sensitivity. The general definitions of the levels are presented, followed by the resource criteria and results.

52148 (DOE/OR/00033—T414) **Factors influencing reproduction of female white-tailed deer on the Savannah River Plant.** Rhodes, O.E. Jr. (Clemson Univ., SC (USA)). May 1987. Contract AC05-76OR00033;AC09-76SR00819. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88015647/JAW.

Data were taken on 1103 pregnant white-tailed deer (Odocoileus virginianus) harvested from the Savannah River Plant (SRP) in South Carolina from 1965--1985 to describe temporal, age-specific, and habitat effects on fetal number. Time periods represented intervals of high and low density. Age significantly affected fetal number both with and without the data from fawns included. Low fetal numbers in yearlings and a high incidence of twinning in older deer were responsible for this effect. Mean number of fetuses per pregnant doe for the 0.5 year old deer ({bar X} = 1.06) was less than for 1.5 ({bar X} = 1.56), 2.5 ({bar X} = 1.73), and ≧3.5 ({bar X} = 1.76) year age classes. Temporal and age-specific effects on fetal number among time periods were significant using data from all age classes. These effects were probably not due to density-dependent feedback mechanisms, but to a sampling bias due to differential representation of age classes or habitat of origin in the statistical analyses. Significant differences were observed in fetal numbers between females from the swamp and upland areas both with and without fawn data. Differences between the densities and/or habitat quality in the 2 areas were responsible for this effect. Data were gathered on 2542 female white-tailed deer harvested on the SRP from 1967 to 1985. 48 refs., 3 figs., 6 tabs.

52149 (EPRCF—8601) **FY 1985 Annual report of the Environmental Pollution Research Center of Fukui Prefecture.** (Environmental Pollution Research Center of Fukui Prefecture (Japan)). Oct 1986. Vp. (In Japanese). Environmental Pollution Research Center of Fukui Prefecture, Fukui, Japan.

Individual chapters are included separately for the data bases.

52150 (OPRCE—8601) **FY 1986 Annual report of Okayama Perfectural Research Center of Environment and Public Health.** (Okayama Prefectural Research Center of Environment and Public Health (Japan)). Jul 1986. Vp. (In Japanese). Okayama Prefectural Research Center of Environment and Public Health, Okayama, Japan.

Individual papers are processed separately for the data bases.

5106 Regulations

REFER ALSO TO CITATION(S) 52137, 52187, 52192

52151 **(AD-A—193502/2/XAB) Installation-restoration program. Technical support document for record of decision, Cape Newenham, AFS. Final report.** (Woodward-Clyde Consultants, Anchorage, AK (USA)). 18 Jan 1988. 76p. NTIS, PC A05/MF A01.

This record of decision and supplemental support document applies to six potential hazardous-waste sites identified at Cape Newenham AFS. The recommendations for all six sites are the same; therefore, a single document for the entire installation is warranted. Information presented in this document supports a finding that there is no significant impact on human health or the environment from suspected or confirmed past contamination at the Cape Newenham AFS. The recommended remedy is no further action with regard to investigation or clean-up of six (6) sites identified as possible areas of contamination at the Air Force station.

52152 **(PB—88-866819/XAB) Inland wetlands legislation and management. January 1970-July 1988 (Citations from the NTIS data base). Report for January 1970-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 112p. NTIS PC N01/MF N01.

Supersedes PB—87-854576.

This bibliography contains citations concerning Federal and state laws and management programs for the protection and use of inland wetlands. Utilization of wetlands to control highway runoff and community waste water is discussed. Wetlands protection programs, restoration projects, resource planning, and wetlands identification methods are cited. References to coastal and salt-water wetlands are excluded from this bibliography. (This updated bibliography contains 179 citations, 11 of which are new entries to the previous edition.)

52 ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 52054

5201 Basic Studies

REFER ALSO TO CITATION(S) 51798, 51933, 52169

52153 **(DOE/ER/60515—2-Pt.1) Dissolved organic matter and lake metabolism: Biogeochemistry and controls of nutrient flux dynamics in lakes: Technical progress report, 1 July 1987--30 June 1988.** Wetzel, R.G. (Michigan Univ., Ann Arbor (USA). Dept. of Biology). 1988. Contract FG02-87ER60515. 56p. (COO—1599-323-Pt.1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016540/JAW.

Our work has continued and expanded in the region of nutrient fluxes, uptake mechanisms, and recycling in microcommunities on the plants and within the plants. Limiting nutrient factors are dissolved inorganic carbon, phosphorus, and in some cases, nitrogen. The macrophyte-epiphyte complex exists in a viscous medium where regions of greatly reduced flow and no turbulence occur at surfaces. As a result of the greatly reduced flow, lack of turbulence,and extremely slow rate of diffusion in water, diffusional processes predominate within the boundary layer. During periods of high metabolic activity (i.e., during photosynthesis) nutrients are likely to become depleted within the boundary layer, constraining production and placing the macrophyte and associated microflora in direct nutrient competition. Once nutrients have entered the complex via diffusion or sedimentation from the bulk phase, or uptake through the macrophyte rhizosphere, exit across the boundary layer is retarded. The close juxtaposition of the biota results in a rapid cycling and, ultimately, in concentration of nutrients. This occurs until the end of the macrophyte vegetative life span when the supporting macrophyte loses its integrity and release of dissolved matter exceeds the retentive capacity of the microbiota. A quantity of this material released by the macrophyte is retained in the epiphyton when the macrophyte-epiphyte complex sinks to the sediment. 324 refs., 6 figs.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 50644, 50832, 50840, 50940, 50941, 50942, 51229, 51231, 51232, 51367, 51523, 51744, 51751, 52064, 52083, 52085, 52086, 52091, 52118, 52129, 52130, 52182, 52183, 52466

52154 **(DTH-ISVA-PR—66, pp 29-34) Research activities related to groundwater contamination from landfills.** Hoegh Jensen, K. (Inst. Hydrodyn. and Hydraulic Eng. Tech. Univ. (DK)). Feb 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88770387/JAW.

In Progress report [for the Institute of Hydrodynamics and Hydraulic Engineering].

Groundwater contamination is an interdisciplinary problem which requires investigations of the geological environment, the water-flow behaviour, the transport and dispersion of dissolved contaminants, and the chemical reactions. A proper investigation should involve assessment of the prevailing conditions and prediction of the future spreading of contaminants, either if no action is taken, or if some management option is implemented. On the basis of such investigations the appropriate management strategy can be identified. The need for developing more refined and cost-effective investigation and remediation techniques to support the restoration of the groundwater quality at old landfill sites has promoted the establishment of a major Danish research programme with its basis at the Technical University of Denmark. (EG).

52155 **(DTH-ISVA-PR—66) Progress report [for the Institute of Hydrodynamics and Hydraulic Engineering].** (Danmarks Tekniske Hoejskole, Lyngby. Inst. for Stroemningsmekanik og Vandbygning). Feb 1988. 62p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88770387/JAW.

A progress report dated February 1988 from the Danish Institute for Hydrodynamics and Hydraulic Engineering is presented.

52156 **(EML—514) Trace element concentrations in transplanted and naturally occurring Unionidae mussels, water, sediments, and macrophytes in Cayuga Lake.** Silvestri, S.; Heit, M.; Klusek, C.S. (USDOE Environmental Measurements Lab., New York). Aug 1988. 76p. NTIS, PC A05/MF A01. Order Number DE88016988/JAW.

This report is a compilation of element concentration data for an EML program whose goal is to determine the environmental fate of combustion-produced pollutants released from a coal-fired electric generating station into an aquatic ecosystem. Because of the enormity of the data set, we have prepared this document to present the data base which will be used in our future interpretive scientific publications. The concentration data for 22 trace elements are reported for naturally occurring fresh water (Unionidae) mussels, macrophytes, lake water, and littoral sediments obtained from Cayuga Lake, NY, the site of the study. Also reported are concentration data for mussels collected from northern Lake George, NY which were transplanted into various locations in Cayuga Lake for periods of up to two years, recovered, and analyzed for the same trace elements. The description of the sampling sites, sampling methodologies, and the results of the analytical quality control programs are presented. Ratios of trace elements in different compartments of the Cayuga Lake ecosystem and correlation coefficients determined by comparing element concentrations in the biota, water, and sediment with distance from the coal-fired power plant are also presented. 21 refs., 2 figs., 33 tabs.

52157 **(EPRI-CS—5910-Vol.1) Round-robin study of methods for trace metal analysis: Volume 1, Atomic absorption spectroscopy, Part 1: Final report.** Maddalone, R.F.; Scott, J.W.; Frank, J. (Electric Power Research Inst., Palo Alto, CA (USA); TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div.). Aug 1988. 790p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015252/JAW.

The objective of this phase (Analytical Methods Qualification) research is to develop validated precision and bias statements for selected elements determined by Graphite Furnace Atomic Absorption (GFAAS) in utility matrices. Six elements (arsenic, chromium, copper, lead, nickel, and selenium) were validated in six utility matrices (river water, ash pond overflow, seawater intake, seawater discharge, treated chemical metal cleaning wastes, and reagent grade water) through interlaboratory round robin testing. Except for arsenic and selenium where Gaseous Hydride AAS (GHAAS) was used by 6 laboratories, only GFAAS was used by the participants to analyze the test samples. Each test matrix was spiked and split into 4 concentrations: a background and 3 samples of increasing concentration. Depending on the matrix, a total of approximately 40 utility laboratories participated in the study. A statistical analysis program based on ASTM D2777-85 was developed and used to produce statements of precision and bias for each element and method. The raw and outlier free data distributions were tested for normality. The precision data were used to compute limits of detection (LOD) and quantitation (LOQ) for all the elements by matrix. Results tend to indicate the inappropriateness of using single operator, single laboratory data to represent routine monitoring capability in utility matrices. 22 refs., 98 figs., 38 tabs.

52158 **(FMPC—2120) The determination of calcium, magnesium, and sodium in wastewater by inductively coupled plasma spectroscopy.** Barnes, B.S.; Volesky, A.F. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). Oct 1988. Contract AC05-86OR21600. 15p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88016502/JAW.

Inductively coupled plasma-atomic emission spectroscopy (ICP-AES) has been used for the determination of calcium, magnesium, and sodium in industrial wastewater samples. The method developed employs the Qualitative mode of a Leeman Labs Plasma-Spec III Inductively Coupled Plasma (ICP) Spectrometer. Analytical results using the Qualitative mode were compared to those obtained using ICP Sequential analysis, flame atomic absorption spectrophotometry (AAS), and flame emission. 1 ref., 6 tabs.

52159 (FSJ—8601, pp 79-82) **Metal-capturing agents derived from refuse of coal for treating waste containing heavy metals (3).** Hanashita, Kazuhiko; Ida, Shiro; Nishiyama, Yasuhiro. (Mitsui Mining Co., Ltd., Kitakyushu Coking Works, Fukuoka, Japan; Mitsui Miike Chemical Engineering Co., Ltd., Tokyo, Japan). 23 Oct 1986. (In Japanese). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754546/JAW. (CONF-8610431—).

From 23. conference of coal science; Fukuoka, Japan (23 Oct 1986).

A test for removing heavy metals contained in various waste waters was made using the heavy metal-capturing agent, Metal Sorber (MS), manufactured from the slime of coal. The test for the waste water of a radiator repair shop was carried out adding 8 to 16 g/l of MS at pH of 6 to 11 by stirring for two hours and the treated waste water met the requirements specified in the regulations. The tests of waste waters of barrel polishing and glass polishing were made adding 2 g/l of MS at pH of 11.5 by stirring for two hours followed by leaving at rest for 16 hours and the treated waste waters met the requirements specified in the regulations. Most of Mg in the waste water of a refuse incinerator was able to be removed in the test carried out adding 5 g/l of MS at pH of 4 to 10. MS is an ion exchanger mainly composed of CaO, CaS and FeS. The heavy metals contained in waste water are, therefore, coprecipitated in the forms of M-O H and MS. In addition, MS has another function to substitute Ca contained in MS for the heavy metals. (3 figs, 3 tabs, 2 refs)

52160 **(GSF—33/87) EXWAT - a multicompartment model of suspended matter transport in surface bodies of water.** Brueggemann, R.; Muenzer, B. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien). Dec 1987. 148p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754300/JAW.

The EXWAT model describes typical processes in flowing bodies of water, e.g. volatilisation, sorption to suspended matter, sorption to the sediment matrix, degradation reactions, transport in the form of dissolved particles, transport in the form of particles bound to suspended matter, and stratification processes in the sediment layer. The model describes a segment of river through which water flows at a given volume flow rate. The segment comprises two compartments, i.e. a fluid compartment containing the moving water and suspended matter, and the sediment compartment consisting of pores and a solid matrix which is assumed to be stationary. The sediment compartment in the model consists only of the top sediment layer, which is considered to be well-mixed. The fate of a chemical substance in the deeper sediment layers is described by the 'sediment stratification rate'. The descriptors used in EXWAT, as in the other submodels of E4CHEM, take account of the hazardousness specifications of the Chemical Substances Act.

52161 **(PB—88-219456/XAB) Contaminant transport from Elliott and Commencement Bays. Technical memo.** Curl, H.C.; Baker, E.T.; Bates, T.S.; Cannon, G.A.; Feely, R.A. (Pacific Marine Environmental Lab., Seattle, WA (USA)). Apr 1988. 147p. (NOAA-TM-ERL-PMEL—78). NTIS, PC A07/MF A01.

Contaminant transport from Elliott and Commencement Bays to the main basin of the Puget Sound was investigated by the Pacific Marine Environmental Laboratory during the spring and summer of 1985 and January of 1986. Distributions of water properties (salinity, suspended particulate matter, and toxic trace metals and organics) were mapped during periods of high river runoff and during combined sewer outflow after heavy rainfall. Results indicate that: (1) dissolved contaminants remain in the very thin, freshwater plume and are transported through the bays into the main basin quite rapidly; (2) PCB and DDT isomers were undetectable in either bay; and (3) there was no evidence that resuspension and transport of contaminated bottom sediments was taking place in Elliot Bay. These results must be qualified due to the short periods during which measurements were taken.

52162 **(PB—88-219464/XAB) Sources and sinks of Pb, Cu, Zn, and Mn in the main basin of Puget Sound. Technical memo.** Paulson, A.J.; Feely, R.A.; Curl, H.C.; Crecelius, E.A.; Romberg, G.P. (Pacific Marine Environmental Lab., Seattle, WA (USA)). Apr 1988. 32p. (NOAA-TM-ERL-PMEL—77). NTIS, PC A03/MF A01.

Municipal, industrial, and atmospheric sources contributed 66% of the total Pb added to the main basin of Puget Sound. Advective inputs were the major sources of total Cu and Zn (approximately 40%) while riverine and erosional sources contributed about 30%. The discharge of the particle-bound trace metals from rivers minimized the impacts of particulate anthropogenic sources, which constituted 50%, 23%, and 18% of the total particulate Pb, Cu, and Zn inputs, respectively. While advective transport was the major source of dissolved Cu and Zn (approximately 60% of all dissolved inputs), industrial, municipal and atmospheric inputs contributed 85%, 30% and 38% of the dissolved Pb, Cu and Zn inputs, respectively. Diffusion of dissolved Mn was the major source of Mn to the main basin. About 75% of the dissolved Pb discharged into the main basin of Puget Sound was lost from the dissolved phase and was balanced by a similar gain in the particulate phase. Because of the effective retention of particles within the main basin, extensive scavenging resulted in about 70% of the total Pb added to the main basin being retained in the underlying sediments.

52163 **(PB—88-220488/XAB) Toxicity reduction evaluation at the Patapsco Waste Water Treatment plant. Final report, April 1986-September 1987.** Botts, J.A.; Braswell, J.W.; Sullivan, E.C.; Goodfellow, W.L.; Sklar, B.D. (Engineering-Science, Inc., Fairfax, VA (USA)). Jun 1988. 328p. NTIS, PC A15/MF A01.

The EPA and the City of Baltimore (City) entered into a cooperative agreement to perform a TRE research study at the City's Patapsco Waste Water Treatment Plant (Patapsco WWTP). The Patapsco WWTP TRE represents one of the first case histories of a toxics management program at a municipal waste-water treatment plant. The study characterized treatment plant influent and operations data and related these data to waste-water toxicity and inhibition data; characterized the plant's influent and effluent wastewater toxicity using definitive EPA bioassays and in-plant toxicity monitors; evaluated the fate of toxicity and specific toxic chemicals during treatment; and evaluated techniques to trace toxicity to its source and to identify specific components of toxicity. A major reduction in toxicity was achieved by the Patapsco WWTP; substantial acute and chronic toxicity was present in the Patapsco WWTP effluent. The waste-water fractionation/identification procedures identified nonpolar organic compounds as the principal toxicants while compounds removed by volatilization and ammonia contributed lesser amounts of toxicity.

52164 **(PB—88-866579/XAB) Polyelectrolytes: wastewater and sewage treatment. January 1977-June 1988 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-June 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 149p. NTIS PC N01/MF N01.

Supersedes PB—86-867694.

This bibliography contains citations concerning polyelectrolytes in waste water and water treatment. Topics include flocculation, coagulation, separation techniques, pollutant identification, water pollution sources, sludge dehydration, and descriptions of specific studies. Hospital waste water processing, methods of synthesizing polyelectrolyte complexes, and performance evaluations of polyelectrolytes are discussed. (This updated bibliography contains 257 citations, 22 of which are new entries to the previous edition.)

52165 **(PB—88-866777/XAB) Heavy metals in drinking water: standards, sources, and effects. January 1970-June 1988 (Citations from the NTIS data base). Report for January 1970-June 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 114p. NTIS PC N01/MF N01.

Supersedes PB—87-853321.

This bibliography contains citations concerning the presence of heavy metals in drinking water. The effects of plumbing systems on water quality is discussed. Standards for safe drinking water are included. Treatment techniques to remove heavy metals are described. Methods for analyzing heavy-metal contaminants in water are presented. The effects of heavy metals in drinking water on human health are briefly considered. (This updated bibliography contains 159 citations, 19 of which are new entries to the previous edition.)

52166 **(PNL—6581-Vol.1) Ground-water monitoring compliance projects for Hanford Site facilities: Progress report for the period January 1--March 31, 1988: Volume 1, Text.** (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016531/JAW.

This report describes the progress of eight Hanford Site ground-water monitoring projects for the period January 1 to March 31, 1988. The facilities represented by the eight projects are the 300 Area Process trenches, 183-H Solar Evaporation Basins, 200 Areas Low-Level Burial Grounds, Nonradioactive Dangerous Waste Landfill, 216-A-36B Crib, 1301-N Liquid Waste Disposal Facility, 1325-N Liquid Waste Disposal Facility, and 1324-N/NA Surface Impoundment and Percolation Ponds. The latter four projects are included in this series of quarterly reports for the first time. This report is the seventh in a series of periodic status reports; the first six cover the period from May 1, 1986, through December 31, 1987 (PNL 1986; 1987a, b, c, d; 1988a). This report satisfies the requirements of Section 17B(3) of the Consent Agreement and Compliance Order issued by the Washington State Department of Ecology (1986a) to the US Department of Energy-Richland Operations Office. 13 refs., 19 figs., 24 tabs.

52167 **(SNV—3074) Liming of ground water by means of reinfiltration. Results from a field test performed at a municipal ground water well.** Gedda, C. (Kjessler et Mannerstraale AB, Halmstad (Sweden)). (National Swedish Environmental Protection Board, Solna). Oct 1985. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754422/JAW.

The report presents a study of a newly developed method of alkalizing (neutralizing) corrosive ground water at a municipal ground water well by reinfiltration to the aquifer of the groundwater alkalized by slaked lime. The study comprises hydrogeologic investigations, model studies and a full scale field test running for six months at the municipal water supply plant of the town Ljungby in southern Sweden. The results obtained indicates that: -It is possible to reduce the corrosive properties of the ground water substantially by reinfiltrating ground water treated with slaked lime. -Considerable improvement of the general ground water quality; increase of the low pH-value; reduction of the carbon dioxide content; increase of the hardness; increase of the alkalinity; reduction of iron and manganese; reduction of the aluminium content. - The method is simple and require little maintenance. -The economy of the operation is good, because the positive effects of the method directly results in reduced chemical treatment costs at the water works. -If the water in the aquifer has a high iron and manganese content, the reinfiltration results in a reduction of these metals. -Due to good buffer capacity of the aquifer, there will be no drastic changes in water quality due to occasional stand stills of the reinfiltration. -Operation of the liming equipment is independent of frost and low temperature. -The construction of the lime dissolver equipment is robust, with safe performance. It can be operated without access to electricity. The use of this liming method should apart from other types of Swedish glacifluvial aquifers, also be applicable to any aquifer of similar hydrological conditions.

52168 **(SNV—3131) Simple liming devices for dug ground water wells.** Gedda, C.; Nilsson, F. (Kjessler and Mannerstraale AB, Halmstad(SE)). (National Swedish Environmental Protection Board, Solna). Jul 1986. 62p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88754424/JAW.

This report presents the studies and development of a new method of alkalizing (neutralizing) corrosive ground water in small dug wells by treatment with lime and air in the well. The study comprises several wells situated in southern Sweden. A summary of the results indicates that: It is possible to substantially reduce the corrosive properties of ground water by lime-treatment and aeration. Considerable improvement is achieved by: -increase of the low pH-value (1-1.5 units); -increase of the hardness; -increase of the alkalinity (to about 60 mg HCO/sub 3//l); -increase of the oxygen content of the water; -reduction of the carbon dioxide content. (authors).

52169 **(SNV—3154) Acidification history of lakes inferred from the subfossil diatoms in the sediments.** Renberg, I. (Umeaa Univ. (Sweden). Inst. foer ekologisk botanik). (National Swedish Environmental Protection Board, Solna). Jul 1986. 37p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88754426/JAW.

Diatom valves preserved in lake sediments can be used to assess changes in lake water pH during the whole postglacial period (Holocene) and so can provide evidence for recent acidification. Various techniques to infer past pH values from subfossil diatom assemblages in sediment cores are outlined. The main part of the report discusses investigations of the acidification history of lakes in NW Europe and N America. These investigations indicate that a slow, long term postglacial acidification is a natural process in areas with resistant bedrock and base poor soils. They also show that acidification has accelerated within the industrial timeperiod,

particularly during the last few decades. A recent pH decrease of between 1 to 1.5 pH units is usual. With 76 refs.

52170 **(TVA/ONRED/AWR—88/2) PCB concentrations in Wilson Reservoir catfish, 1986.** Dycus, D.L.; Lowery, D.R. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Aug 1987. 49p. NTIS, PC A03/MF A01. Order Number DE88016103/JAW.

For three years TVA has been involved in a study on Wilson Reservoir to evaluate the year-to-year trend in PCB concentrations in catfish. Samples taken the first year of study (1984) revealed 22 of 45 catfish equaled or exceeded the FDA tolerance of 2.0 μg/g, and the overall average was 2.6 μg/g. As a result of these findings, the Northwest Alabama Regional Health Department issued an official notice to retail markets in June 1985 to discontinue selling catfish from Wilson Reservoir. 3 refs., 4 figs., 9 tabs.

52171 **(TVA/ONRED/AWR—88/14) Effect of dissolved oxygen concentrations on fish and invertebrates in large experimental channels.** Heuer, J.H.; Seawell, W.M. (Tennessee Valley Authority, Knoxville (USA). Office of Natural Resources and Economic Development). Jul 1987. 39p. NTIS, PC A03/MF A01. Order Number DE88016074/JAW.

The responses of fish (smallmouth bass, channel catfish, golden shiners, and bluegill), zooplankton, and benthic macroinvertebrates to various levels of dissolved oxygen (DO) were monitored in six large outdoor channels at TVA's Aquatic Research Laboratory at Browns Ferry Nuclear Plant. Nitrogen stripping was used to remove oxygen from the water, and aquatic organisms were exposed to target levels of 5, 4, 3, and 2 mg/L (2 channels) and to an untreated control from July 24, 1984 until September 24, 1984. Responses of adult golden shiners, bluegill, and channel catfish to DO were not consistent, probably because of predation by smallmouth bass on golden shiners and competition between bluegill and channel catfish. Bluegill spawned successfully only in the control. Cleaned nests were found in the 5 mg/L treatment and partially cleaned nests in the 3 and 4 mg/L treatments, but no evidence of nesting was found in the 2 mg/L treatment. 14 refs., 8 figs., 7 tabs.

52172 **(TVA/ONRED/AWR—88/25) Pesticide use in Kentucky reservoir watershed.** Butkus, S.R. (Tennessee Valley Authority, Chattanooga (USA). Div. of Air and Water Resources). Jun 1988. 45p. NTIS, PC A03/MF A01. Order Number DE88016109/JAW.

This report summarizes information on the types, uses, and amounts of pesticides applied to Kentucky Reservoir and its immediate watershed. Estimates for the quantities and types of the various pesticides used are based primarily on the land uses in the watershed. A listing of commonly used pesticides is included describing their uses, mode of action, and potential toxicological effects. This report will inform the the public and the Kentucky Reservoir Water Resources Task Force of the general extent of pesticide usage and is not an assessment of pesticide impacts. 10 refs., 5 figs., 9 tabs.

52173 **(UCRL—21008-Vol.3) Evaluation of military field-water quality: Volume 3, Opportunity poisons.** Ciccone, V.J.; Carmer, M.B.; Daniels, J.I. (ed.). (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 44p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016177/JAW.

The term "opportunity poison" refers to any substance that in military situations might be intentionally added to field water to deny its use; it implies that such contamination will be introduced as a spontaneous action, rather than as part of a preconceived plan. There are many different substances in military inventories and the civilian marketplace that, because of their availability and toxic or organoleptic properties (e.g., taste, odor, or appearance), can be considered potential opportunity poisons for field water. To identify these substances and indicate their relative importance from a military perspective, we present a categorization matrix in which classes of compounds are ranked according to their military significance as potential opportunity poisons. The categorization matrix was assembled by considering (1) the probable availability from military or civilian sources, (2) the possible water-related health or aesthetic effects, and (3) the potential impacts on water-treatment equipment of the principal constituents of each class of compounds. On the basis of the analysis, recommendations are made for US military forces to meet the threat of opportunity poisons by instituting guidelines and training programs that will (1) alert field forces to situations likely to involve the use of opportunity poisons and (2) define appropriated procedures for dealing with such situations. Quantifying the effects of the most important opportunity poisons (e.g., petroleum products) on field-water treatment equipment, particularly the reverse osmosis water purification unit (ROWPU), also is advised so that contingency plans can be made for operating and maintaining the equipment in the presence of such opportunity poisons. 149 refs., 8 tabs.

52174 **(UCRL—21081) In situ detection of organic molecules.** Angel, S.M.; Langry, K.C.; Kulp, T.J.; Daley, P.F.; Bishop, D.J. (Lawrence Livermore National Lab., CA (USA)). 15 Aug 1988. Contract W-7405-ENG-48;AC05-84OR21400. 50p. (DOE/HWP—66). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016646/JAW.

We have developed a new fluorescence-based chemical indicator for detecting chloroform and trichloroethylene. We have isolated and identified the fluorescent products resulting from this assay using modern spectroscopic techniques. We describe the details of this reaction, its putative reaction sequences with chloroform and trichloroethylene, and present an analysis of the spectral data obtained from the reaction products. We have made preliminary measurements using a fiber optic chemical sensor (optrode) for monitoring groundwater contamination that exploits this new fluorescence-based indicator for chloroform and trichloroethylene. We report details of the sensor configuration and the chemical reagents employed in the transduction chemistry. We have developed for this optrode a technique that permits the selective detection of chloroform in the presence of trichlorethylene and discuss approaches to selectively measure trichloroethylene in the presence of chloroform. The results of preliminary measurements of trichloroethylene with optrodes that contain our new chemical indicator are outlined in this report. We report on the syntheses of several compounds that we will evaluate to improve the luminescence properties of the fluorescence-based test for chloroform and trichloroethylene. 24 refs., 24 figs., 2 tabs.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 50798, 50806, 50832, 50839, 50840, 50841, 50845, 51229, 51230, 51231, 51232, 52064, 52103, 52117, 52118, 52122, 52123, 52138, 52142, 52144, 52166, 52182

52175 **(BARC—1397) Study of dilution of effluent discharged through a sea outfall near Mangalore using radiotracer technique.** Eapen, A.C.; Jain, S.K. (Bhabha Atomic Research Centre, Bombay (India). Isotope Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704086/JAW.

The fate of effluent discharged into water bodies is a matter of concern from the point of view of environmental pollution. Radiotracer techniques have been successfully used to study the change in concentration of effluents while being mixed with large water bodies. The technique used is to add a known concentration of radioactive tracer into the effluent stream and to measure the dilutions at different locations near the effluent discharge point with radiation detectors. M/s Mangalore Chemicals and Fertilizers Ltd (MCF) at Mangalore on the west coast of India disposes off the treated and initially diluted effluent at the rate of about 360 m/sup 3//h into the sea near by through an outfall extending about 100 meters into the sea. The effluent mainly contains ammonia in the range of 40-50 ppm as the pollutant. It was desired to measure the extent of dilution occurring to the effluent at a few locations of known distances along the sea shore from the discharge point of the effluent. Radiotracers /sup 82/Br as ammonium bromide solution and tritium as tritiated water were employed for the study. The concentration measurement was done at site for /sup 82/Br and by estimation of samples in the laboratory in the case of triti-

um. Dilution of the order of 1000 was obtained at about 100 meters distance for a continuous injection of about 4 hours. (author). 3 tables, 3 figures.

52176 **(BfG—0405) Chernobyl accident and its direct and late effects an surface bodies of water in Germany.** Mundschenk, H.; Wengler, P. (Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.)). Sep 1987. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754642/JAW.

Effects on the tritium content (monthly composite samples) of German surface waters could not be detected. After the nuclear reactor accident in Chernobyl, however, the increased radioactive content in the Rhine and the Moselle could easily be detected in the samples of May 1986 by means of the residual β determination. The Sr-90 contents of up to 0.010 Bq/l measured in the Rhine and the Moselle were only slightly higher than the values measured in 1985. For the nuclide ratio Sr-89/Sr-90, measured in rainwater samples, a value of 18.7 +-8.7 (n=10) was determined. An extraordinary high nuclide content was observed in the solids contained in water (suspended matters, sediments). Cs-137 contents of up to 6000 Bq/kg TM were measured in suspended matter samples from the Moselle (monthly composite samples). A careful analysis of the activity quotient, adjusted to decay, measured in different German river areas on samples of suspended matters, sediments, and - with restrictions - of rainwater, showed a distinct increase in South-North direction. This regional fractionation can obviously be set in correlation with the local conditions of the place of release.

52177 (CONF-760202—, pp 722-726) **Filter-resin sampling method for measurement of radioactivity in Columbia River water.** Fix, J.J.; Robertson, D.E. (Pacific Northwest Labs., Richland, WA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Several radionuclides present in Columbia River water have been measured since 1973 by using a filter-resin sampler to remove most radionuclides from the water during biweekly sampling periods and by counting directly and separately the filters and resin with a high sensitivity multi-dimensional (coincidence) gamma ray spectrometer. Insoluble (collected on filters) and soluble (adsorbed onto resin) concentrations of several radionuclides are observed and used to determine the probable origin of the activity. To date, all of the observed concentrations are less than 0.01% of the most restrictive ERDA Manual Chapter 0524 guidelines for drinking water. The radionuclides observed include: ^{40}K, ^{54}Mn, ^{60}Co, ^{65}Zn, $^{95}ZrNb$, ^{106}Ru, ^{137}Cs, ^{152}Eu, ^{226}Ra, and ^{228}Th.

52178 (INIS-mf—11261, pp 67-71) **Impact of complexing agents employed in nuclear power industry on NPP cooling pools.** Marchyulenene, D.P.; Legin, V.G.; Moteyunene, Eh.B.; Kuznetsov, Yu.V.; Shchuliene, R.I.; Bobrov, S.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

The results of a study of the most promising for the nuclear power complexing agents, such as ethylenediaminetetraacetic (EDTA), oxyethylydenediphospphone (OEDP) and diethylenetriaminepentaacetic (DTPA) acids, are presented. The impact of these agents on Ce-144 and Sr-90 radionuclides behaviour in fresh and semi-saline water, on their accumulation by hydrobionts and the evolution of the latter has been investigated. The specific features of behaviour of the mentioned radionuclides which are usually present in typical NPP liquid radioactive wastes were analysed in case of their getting into natural waters in the form of complexonates.

52179 (INIS-mf—11261, pp 41-47) **Radiation impact on population from liquid discharges of NPPs in the USSR.** Pavlovskij, O.A.; Gusev, D.I.; Stepanova, V.D.; Grachev, M.I.; Smirennaya, V.A.; Sakharova, P.G.; Markelova, V.F. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Data on liquid discharges based on operation experience of Armenian, Kol'skaya, Beloyarskaya, Kurskaya and Chernobyl'skaya NPPs are presented and evaluated. The population dose commitments due to economic utilization of the NPP cooling pools are estimated. Their contribution to the total dose commitment of a man has been shown to be small. The dose commitment for critical population groups through all the pathways of the radiation impact from the pool amounts up to 5 Sv/year. This value is 3 order of magnitude lower than the dose limit established by the sanitary regulations in the USSR for the specific population and does not exceed 10% from the partial dose load on population due to liquid radioactive discharges from the NPP. 6 refs.; 2 tabs.

52180 (INIS-mf—11261, pp 48-52) **Gas/aerosol wastes of Novo-Voronezh NPP and evaluation of the environment contamination.** Doroshenko, G.G.; Leonov, E.S.; Panchenko, S.V.; Baranov, M.A.; Sedov, V.K.; Sinyukova, N.I. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Data on the actual gas/aerosol discharges of Novo-Voronezh NPP are reviewed over the total time of its operation. The interrelation between the discharge levels and various maintenance operations is analysed. The long-living aerosol accumulation levels in the environment are estimated on the basis of the discharge monitoring data. The results of multi-years observations of the actual environment contamination are discussed, the actual measured gas/aerosol discharge data presented. The comparison of the radionuclides fallouts within the NPP region and in Moscow district has shown the radiation conditions near the NPP to be governed by the global fallouts. 6 refs.; 2 tabs.; 1 fig.

52181 **(PAEC(A)-IE—86015) Tritium concentrations in environmental water and food samples collected around the vicinity of the PNPP-1.** Garcia, T.Y.; Enriquez, S.O.; Duran, E.B. (Philippine Atomic Energy Commission, Diliman, Quezon City). 1986. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703466/JAW.

The natural radioactivity levels of tritium in environmental samples collected around the vicinity and more distant environment of the first Philippine Nuclear Power Plant (PNPP-1) in Bataan were assessed. The samples analyzed consisted of water samples such as seawater, freshwater, drinking water, groundwater and rainwater; and food samples such as cereals, vegetables, fruits; meat, milk fish and crustaceans. Tritium concentrations in water samples were determined by distillation and liquid scintillation counting techniques. The food samples were analyzed for tissue-free water tritium by the freezing-drying method followed by liquid scintillation counting techniques. (Auth.) 13 refs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 50940, 50941, 50942, 51073, 51367, 52166, 52465

52182 **(PNL—6654) Hanford site ground-water monitoring data listing, January 1--March 31, 1987.** Bryce, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016518/JAW.

Pacific Northwest Laboratory (PNL) is conducting groundwater monitoring at the Hanford Site, near Richland, Washington. This document contains a data listing of results for monitoring by PNL and Westinghouse Hanford Company (WHC) during January through March 1987. 4 refs.

52183 **(WHC-EP—0142) Ground-water maps of the Hanford Site Separations Area, December 1987.** Schatz, A.L.; Ammerman, J.J. (Westinghouse Hanford Co., Richland, WA (USA)). Mar 1988. Contract AC06-87RL10930. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015597/JAW.

The ground-water maps of the Separations Area are prepared by the Environmental Technology Section of the Defense Waste Management Division of Westinghouse Hanford Company. The Separations Area consists of the 200 East and 200 West Areas, where chemical processing activities are carried out. This set of ground-water maps consists of a water-table map of the unconfined aquifer, a depth-to-water map of the unconfined aquifer, and a potentiometric map of the uppermost confined aquifer (the Rattlesnake Ridge sedimentary interbed) in the area where West Lake, the deactivated Gable Mountain Pond, and the B Pond system are located. The Separations Area water-table map is prepared from water-level measurements made in June and December. For the December 1987 map approximately 200 wells were used for contouring the water table. The water-table mound beneath the deactivated U Pond has decreased in size since the June 1987 measurements were taken, reflecting the impact of shutting off flow to the pond in the fall of 1984. This mound has declined approximately 8 ft. since 1984. The water-table map also shows the locations of wells where the December 1987 measurements were made, and the data for these measurements are listed.

5206 Regulations

REFER ALSO TO CITATION(S) 52151, 52152, 52165

52184 **(PB—88-220926/XAB) Superfund Record of Decision (EPA Region 9): San Gabriel Area 1 site, California (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 77p. (EPA/ROD/R—09-87/015). NTIS, PC A05/MF A01.

See also PB—85-214120.

In 1980, the State of California, in an extensive well-water testing program in the San Gabriel basin, found numerous wells contaminated with TCE, PCE, and other chlorinated hydrocarbons. In May 1984, EPA Region IX's Regional Administrator signed a Record of Decision (ROD) selecting air-stripping treatment as the most cost-effective initial remedial measure (IRM) to provide the three mutual water companies in El Monte with a source of uncontaminated water. The selected interim remedial action for the site includes: installation of an activated-carbon adsorption system for treatment of well discharge at the Richwood Mutual Water Company completion of the design and development of bid documents for the Rurban Homes system, monitoring of this system with implementation of a carbon adsorption system if monitoring results show an increase in well-contaminant levels; and based on future determinations, if necessary, an upgrade to the Hemlock system. The estimated capital cost for the selected remedy is $1,616,100 - $1,771,800 with annual O&M of $181,400 - $303,100.

52185 **(PB—88-220934/XAB) Superfund Record of Decision (EPA Region 9): Stringfellow acid pits site, Glen Avon, California (second remedial action), June 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Jun 1987. 46p. (EPA/ROD/R—09-87/016). NTIS, PC A03/MF A01.

See also PB—85-214153.

The Stringfellow site is located in Riverside County, California. Approximately 34,000,000 gallons of industrial waste, primarily from metal finishing, electroplating, and DDT production were deposited in onsite evaporation ponds. In 1972, the site was voluntarily closed. The primary contaminants of concern affecting onsite and downgradient ground-water include: organics including TCE, inorganics, and metals. The selected remedial action for the site includes: installation of a ground water barrier system in the lower canyon area and treatment of extracted ground water, if necessary, followed by discharge to a publicly owned treatment works installation of a peripheral channel around the north end of the original site to direct upgradient surface-water runoff; and extension of the existing gunite channels southward to discharge surface water to Pyrite Creek.

52186 **(PB—88-220942/XAB) Superfund Record of Decision (EPA Region 2): South Brunswick, New Jersey (second remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 93p. (EPA/ROD/R—02-87/052). NTIS, PC A05/MF A01.

The Browning-Ferris Industries South Brunswick Landfill (BFI) is a closed landfill in Middlesex County, New Jersey. The site is in close proximity to a brook that feeds into a public drinking water supply 10 miles downstream. For more than twenty years the site operated, under two separate owners, as a solid-waste landfill that received municipal refuse, pesticides, chemical wastes and hazardous wastes. The site was officially closed in December 1978. A site investigation revealed elevated levels of VOCs and iron in the ground water and surface water. The selected remedial action for the site includes onsite containment (leachate collection/treatment system, slurry wall, clay cap, gas venting system), which was initiated in May 1983 and completed on September 1985; and post-remedial ground water, surface and air monitoring.

52187 **(PB—88-220959/XAB) Superfund Record of Decision (EPA Region 4): Gold Coast, Florida (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 11 Sep 1987. 85p. (EPA/ROD/R—04-87/028). NTIS, PC A05/MF A01.

The Gold Coast Oil Corporation (GCO) site is located within a commercial/industrial/residential area and located over the Biscayne Aquifer, the sole source aquifer for the area. GCO, along with Solvent Extraction, Inc., were in the business of distilling mineral spirits, lacquer thinner, and reclaiming solvents. Blowdown from these operations was sprayed directly onto the ground and 53 drums of sludge-contaminated soil were stored onsite. No waste was shipped offsite during the 11 years of operation. Investigations of illegally dumped and stored sludge and onsite wells took place in 1980 and in 1981. In 1982 CSX Transportation evicted GCO from the property and agreed to voluntarily clean up the site. Soil and ground water are contaminated with TCE, PCE, other VOCS, lead, and other heavy metals. The selected remedial action for this site are given. The estimated total cost for this remedial action is $3,711,600 with present worth O&M of $74,850.

52188 **(PB—88-220983/XAB) Superfund Record of Decision (EPA Region 8): Central City/Clear Creek, Colorado (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 162p. (EPA/ROD/R—08-87/016). NTIS, PC A08/MF A01.

The focus is on five abandoned mines/tunnels proximal to the cities of Idaho Springs, Black Hawk, and Central City and the influence of acid mine drainage from those tunnels on adjacent stream courses. Surface-water contamination results from acid-mine drainage emanating from the five tunnels and from seepage of ground water through tailings piles both proximal to these tunnels and along stream courses. Approximately 1200 lbs per day of dissolved and suspended metals are discharged to the Clear Creek drainage from the five mine tunnels. These dissolved and suspended metal loadings have resulted in a significant depletion of aquatic life and have potential impact to sediments and downstream users of surface and ground water. There are ten contaminants of concern including aluminum, arsenic, cadmium, chromium, copper, fluoride, lead, manganese, nickel, silver and zinc. Interim remedies are described.

52189 **(PB—88-220991/XAB) Superfund Record of Decision (EPA Region 4): Powersville Landfill, Georgia (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 112p. (EPA/ROD/R—0-87/029). NTIS, PC A06/MF A01.

The Powersville Landfill, which occupies approximately 15 acres, is located in Peach County, Georgia. Disposal records indicate pesticide manufacturing wastes were disposed of in the municipal section of the landfill prior to June 1973 and in the hazardous-waste area between June 1973 and 1978. The landfill was closed in 1979 due to its location in a highly permeable sand and gravel aquifer. The primary contaminants of concern affecting the soil and

ground water include: VOCs (vinyl chloride), organics, heavy metals (lead and chromium), and pesticides. The selected remedial action for the site includes: surface capping of hazardous waste and municipal fill areas using artifical material or clay, with grading, drainage and closure; installation of eight additional monitor wells (at a minimum) in the upper region of the aquifer to determine cap area leaching or migration; and extension of the municipal water-supply pipe line as an alternate water supply.

52190 **(PB—88-221007/XAB) Superfund Record of Decision (EPA Region 5): New Brighton/Arden Hills/TCAAP, Minnesota (third remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1987. 78p. (EPA/ROD/R—05-87/058). NTIS, PC A05.

See also PB—85-213940; Portions of this document are not fully legible.

The Twin Cities Army Ammunition Plant (TCAAP) is located north of the Twin Cities of Minneapolis/St. Paul, Minnesota and comprises the northern edge of the New Brighton/Arden Hills/St. Anthony (NBAHSA) Superfund NPL site. The U.S. Army estimates aproximately 26 pounds per day of VOC contaminants are migrating off TCAAP into the ground water at the southwest boundary of TCAAP. This contamination is migrating in both the Hillside Sand Aquifer and the deeper Prairie du Chien/Jordan Aquifer (both are aquifers that supply water to the cities of New Brighton and St. Anthony). The primary contaminants of concern affecting the ground water include: PCBs, benzene, toluene, TCE, VOCs, arsenic, chromium, lead, and metals. The selected remedial action for this site includes: operation of a six-well system to extract ground water migrating from the southwest corner of TCAAP and treatment with air stripping.

52191 **(PB—88-221015/XAB) Superfund Record of Decision (EPA Region 5): FMC Corporation, Fridley, Minnesota (second remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 73p. (EPA/ROD/R—05-87/059). NTIS, PC A04/MF A01.

The FMC site, in the City of Fridley, Minnesota is approximately 1,000 feet east of the Mississippi River, just north of the City of Minneapolis, and upstream of the City of Minneapolis drinking-water intake. Investigation revealed historical waste-disposal practices and found contamination of the ground water and Mississippi River. Currently underlying ground water and alluvial aquifers with discharge to the Mississippi River are contaminated with trichloroethene (TCE), Porchloroethylene (PCE), benzene, toluene, xylene, and other volatile organic compounds (VOCs). TCE has been estimated to account for 98% of the contaminant loading. The selected remedial action for the site includes: groundwater pump and treatment with discharge to a sewer system; ground-water monitoring; and implementation of institutional controls with land-use restrictions to mitigate against near-term usage of contaminated ground water between the site and the Mississippi River.

52192 **(PB—88-221023/XAB) Superfund Record of Decision (EPA Region 6): Sand Springs Petrochemical Complex, Tulsa County, Oklahoma (first remedial action), 29 September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 96p. (EPA/ROD/R—06-87/024). NTIS, PC A05/MF A01.

The Sand Springs Petrochemical Complex is a 235-acre site in Sand Springs, Oklahoma on the northern bank of the Arkansas River. The site includes acid-sludge pits, a surface impoundment, spray ponds, solvent and waste lagoons, surficial-sludge contamination, solvent and waste oil lagoons and contaminated sediments. While both soil and ground water are contaminated, the Record of Decision addresses surface liquids, sludges and heavily contaminated soils. The primary contaminants of concern are organic pollutants: bis(2-ethylhexyl)phthalate and toluene and inorganic compounds: lead, zinc, chromium, and barium. The selected remedial action for the site is onsite thermal destruction of wastes. ARCO Petroleum Products Company proposed a remedy that includes excavation and offsite thermal destruction of sludges; solidification and/or stabilization of all remaining sludges with containment of the resulting matrix in an onsite hazardous-waste RCRA cell; and implementation of chemical and physical treatability studies.

52193 **(SNV—3079) Environmental data information system. KRUT - the future system in operation.** (National Swedish Environmental Protection Board, Solna). 1986. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754423/JAW.

Within the KRUT project, started in June 1985, a new computer based information system for environmental data will be developed. The system comprises liming, control of recipients and pollution, and is mainly aimed at supervision.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 50771, 50793, 51405

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 50636, 51104

52194 **(ESC-WR—88-13) Impacts of environmental constraints on energy technology. The case of NO/sub x/ in the Netherlands.** Okken, P.A. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). May 1988. 24p. ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Netherlands Energy Research Foundation (ECN) recently completed an extensive study on emerging energy technologies up till the year 2020, to identify areas for research and development. A dynamic LP-model (MARKAL) was used describing the Netherlands energy sector. The model contains technical data for many energy processes, including emission factors and emission abatement techniques (SO/sub 2/, NO/sub x/, VOC) presently available or to be expected in the near future. The impact of environmental constraints is tested in different scenario-runs by imposing exogenous national maximum emission rates. The results are particular reveiling for NO/sub x/ from stationary and mobile sources, because optimal integral NO/sub x/-reduction appears to be a mix of emission abatement techniques and in the long term structural changes in energy technology and fuel mix. 7 figs., 9 refs., 3 tabs., 2 app.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

52195 **(PB—88-219100/XAB) Small target identification. Forest Service project record.** Harrison, R.T. (Forest Service, San Dimas, CA (USA). Equipment Development Center). Feb 1984. 13p. (PR—8457-1202). NTIS, PC A03/MF A01.

The identification, observation, and counting of raptor (hawks, owls, ospreys, eagles, etc.) nests, fledglings, and eggs are accomplished by Forest Service wildlife biologists as part of the eagle recovery effort, the protection of endangered species, and wildlife management in general. One alternative to real-time direct observation would be some sort of a stabilized television platform, equipped with a television camera which has a remotely zoomable lens, and a real-time monitor. The objective of the tests described in the report is to determine if a stabilized, real-time optical system (hereinafter called simply sight) is available to do the raptor observation job.

5502 Biochemistry

REFER ALSO TO CITATION(S) 50870, 50871, 50874, 50956, 50961, 51754, 51768, 51973, 52286, 52315, 52395, 52396, 52399, 52400, 52402, 52408, 52417, 52428, 52429, 52435

52196 (BNL—39428, pp A1) **Models of the distribution of protein in the human body.** Burkinshaw, L. (Univ. of Leeds (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Two principal models have been described that purport to explain how the distribution of protein between certain tissues can be deduced from measured values of total body potassium and total body nitrogen. One estimates how much protein is intracellular and how much is extracellular, and the other estimates how protein is apportioned between skeletal muscle and non-muscle fat-free tissue. An extension of the latter model also estimates protein in the viscera. The theoretical bases of the two principal models will be discussed and a model consistent with both will be proposed. The usefulness of the models for determining the origin of the protein lost by wasted patients will be assessed by applying them to relevant data.

52197 (BNL—39428, pp A2) **Clinical body composition assessment using in vivo neutron activation analysis (IVNAA).** Beddoe, A.H. (Univ. of Auckland (New Zealand)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

A prompt gamma IVNAA facility has been developed in Auckland to study body composition in both the depleted surgical patient and the critically ill intensive car patient. The IVNAA method, used in conjunction with the tritium dilution technique, enables total body protein, water and fat to be determined with precision. This paper reviews clinical research on the protein and hydration status of surgical patients requiring nutritional support as are the changes in proteins and fat achieved with nutritional therapy in pre- and post-operative patients. Results are also presented of a clinical trial which examines the efficacy of fat and glucose as hypercalorific energy sources. The IVNAA/tritium dilution method has for the first time been applied to document body composition changes in intensive care patients and results on critically ill post-operative septic intensive care patients are discussed. Data are also presented for patients who have suffered major blunt trauma. Finally, the method is contrasted with skinfold anthropometry as a means of determining total body fat and also with conventional nitrogen balance as a means of monitoring crude protein changes in the clinical situation.

52198 (BNL—39428, pp A4) **One year follow-up of weight, total body potassium (TBK) and total body nitrogen (TBN) in obese adolescents treated with the protein sparing modified fast (PSMF).** Archibald, E.H.; Stallings, V.A.; Pencharz, P.B.; Harrison, J.E.; Bell, L.E. (Univ. of Toronto, Ontario (Canada)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Seventeen obese adolescents were treated with the PSMF, a high protein (58%), low carbohydrate (7%), low calorie diet (880 cal/d) for approximately 3 months. They were then switched to an iso-caloric diet and reevaluated at 12 months. Body composition was determined by four skinfolds, TBK and TBN at 0, 3 and 12 months. Twelve subjects returned at one year (71%) and eight of the original seventeen sustained weight loss (48%). The mean weight loss was 4.9 kg ($p < .025$) and mean adipose tissue loss was 4.2 kg ($p < .001$). There was no difference between initial and 12 month fat free body mass (FFBM), TBK, TBK/FFBM or TBN/TBK. There was a significant loss of TBN over the 12 months ($p < .001$). However, measured TBN still remained within normal (predicted) range. The authors conclude that the PSMF is an effective means of reducing body fat while at the same time permitting a preservation of lean tissue.

52199 (BNL—39428, pp A5) **Experience in the use of body composition studies in gastroenterology.** Blendis, L.M.; Harrison, J.E.; Mernagh, J.R.; Jeejeebhoy, K.N.; McNeill, K.G. (Univ. of Toronto (Canada)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The measurement of total body nitrogen (TBN) as an index of total protein in the body has been performed in a number of different studies. The in vivo technique is based on the detection and counting of the characteristic nitrogen gamma rays emitted after neutron capture. The accuracy of the method was estimated as better than 10%, reproducibility was 5.5%. The effective dose equivalent for nitrogen measurement is 50 mrem. TBN was initially measured in 121 volunteers and found to correlate best with the mean of height and arm span (HAS), a better estimate of skeletal size than height alone. This was then used to normalize TBN for body size with the derivation of a Nitrogen Index (NI), with a normal range of 0.8 - 1.2. A select group of 38 malnourished patients were treated with total parenteral nutrition for periods of 3 to 33 months. This resulted in a weight gain of 10% and a significant increase of 32% in TBN. In contrast, increases in lean body mass, measured anthropometrically and total body potassium (TBK) were only increased 9%, the later two reflecting total and intracellular water respectively, but not protein content.

52200 (BNL—39428, pp A6) **Rapid estimation of lean body mass by measurement of total body electrical conductivity.** Van Itallie, T.B.; Sega, K.R.; Yang, M.U. (St. Luke's-Roosevelt Hospital Center, New York, NY (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Total body electrical conductivity (TOBEC) has been found to provide an accurate index of lean body mass in infants, children and adults. TOBEC can be measured rapidly (within 90 seconds), comfortably and noninvasively, requiring minimal subject effort and operator skill. Indeed, the method is objective, being inherently judgment- and bias-free. Thus, TOBEC has potential value in the nutritional assessment of individuals and groups. It should be particularly useful in the study of people who, because of illness, age or infirmity, cannot tolerate demanding procedures such as hydrodensitometry. The principle on which TOBEC is based; namely, the fact that the electrical conductivities of extracellular water (ECW) and hydrated lean tissue far exceed that of fat, constitutes both an advantage and a disadvantage.

52201 (BNL—39428, pp A7) **Theory and validation of the tetrapolar bioelectrical impedance method to assess human body composition.** Lukasi, H.C.; Bolonchuk, W.W. (Grand Forks Human Nutrition Research Center, ND (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Tetrapolar bioelectrical impedance plethysmography which is based upon the conduction of an applied electrical current through the conductive tissues of the body. This method introduces a painless, radiofrequency signal through surface electrodes into the deep tissues of the body. Adjacent surface electrodes measure the voltage drop across the body. Phase-sensitive electronics quantitate the impedance to the flow of current into the geometric components of resistance (R) and reactance (Xc). Previous findings from the authors laboratory demonstrated the reliability and importance of conductance measurements, Ht^2/R, to estimate FFM and demonstrated a small error (3.7%) in predicting FFM in a homogeneous sample. To determine the validity and accuracy of this technique for a heterogeneous sample, they studied 300 males and females ages 18-61 yr who underwent anthropometric, densitometric, and bioelectrical impedance determinations. The results establish the validity of the bioelectrical impedance method and indicate acceptable errors in the determination of human body composition in a heterogeneous group of volunteers.

52202 (BNL—39428, pp A8) **Lean body mass and total body fat by dual-photon (^{153}Gd) absorptiometry.** Hassager, C.; Gotfredsen, A.; Christiansen, C. (Univ. of Copenhagen (Denmark)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The authors describe a method for measuring the lean body mass (LBM) and total body fat (FAT) by dual-photon (^{153}Gd) absorptiometry (DPA). Lean percent determination on limb phantoms, revealed precision and accuracy errors below 2.0%. The in vivo precision of the LBM of duplicate measurements on five healthy subjects was 2.2%. The accuracy error in vivo of measuring the total mass of soft tissues was 1.4%, thus yielding an overall accuracy error of the LBM of about 2.5%. Measurements on 100 healthy subjects revealed high correlations between FAT, FAT% or LBM by DPA versus FAT, FAT% or LBM calculated from anthropometric measurements. From DPA measurements of 228 normal adults, multiple regression equations of LBM and FAT based on age, height, and weight were computed. They conclude that DPA measurements of LBM and FAT in vivo is a reliable estimation of the gross body composition, and that LBM and FAT in normal adults can be calculated solely from age, height, and weight with reasonable accuracy for many purposes.

52203 (BNL—39428, pp A9) **Infant body volume measurement by acoustic plethysmography.** Sheng, H.P.; Dang, T.; Schanler, R.; Garza, C. (Baylor College of Medicine, Houston, TX (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

An acoustic plethysmograph has been developed to measure body volume in premature infants. This technique uses the principle of the Helmholtz resonator in which the resonant frequency depends, in part, on the volume of the resonating chamber. Thus, when an infant is placed inside a resonating chamber, the resonant frequency changes in proportion to the body volume of the infant. The prototype system consists of a 20- x 20- x 45-cm plexiglas chamber with a hinged front for access. A loud speaker, driven by a variable frequency tone generator, is aimed at an opening in the top surface of the chamber. The frequency of this tone is controlled by a microprocessor and monitored by a frequency counter for accuracy. The resonant frequency corresponds to the frequency at which the sound level inside the chamber reaches a maximum. This sound is detected by a microphone in the chamber. The sound pressure level was below 75 dBa. The plethysmograph was calibrated by measuring the resonant frequency when objects of known volume were placed in the chamber. The coefficient of variation of calibration measurements was less than 1%.

52204 (BNL—39428, pp A10) **New concepts of body consumption.** Cohn, S.H. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Until fairly recently, data on body composition was derived indirectly. Currently, non-invasive measurements of body compartments provide a more precise picture and lend themselves to models for dynamic representation. New techniques include in vivo neutron activation, photon activation, photon absorptiometry, computed tomography, electrical conductivity, ultrasound, roentgenography, NMR, infrared interactance, coherent Compton scattering, isotope dilution techniques and acoustic plethysmography. Additionally, x-ray fluorescence has been employed for measurements of trace elements. Of the newer techniques, NMR displays a considerable potential which has not, as yet, been exploited. New developments in the means of detecting elements and body components are providing considerably more insight into the structure and dynamics of the human body. The dynamic interrelationships among the body compartments have yet to be explored.

52205 (BNL—39428, pp B1) **Total body calcium and other bone mineral studies in Edinburgh.** Tothill, P. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

For some years the authors have used in vivo neutron activation analysis to measure total body calcium (TBCa). A new method was developed of measuring the total bone mineral in the hand by single-photon absorptiometry with iodine-125 radiation. Precision is 1.9% and the coefficient of variation of normal subjects 13% after normalizing for span and years post menopause. Theoretical calculations on the precision of dual photon absorptiometry for measuring spine bone mineral had earlier shown that Gd 153 was the best source, but that a combination of Am 241 and Cs 137 should be acceptable. The latter pair have now been incorporated into a scanner. Dependence of vertebral bone mineral on size and age was small; after normalization, the coefficient of variation for normal subjects was 14%.

52206 (BNL—39428, pp B5) **Accuracy and precision in the in vivo determination of bone minerals content using the attenuation of a continuous x-ray spectrum.** Jonson, R.; Roos, B.; Hansson, T.; Mattsson, S. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

An x-ray technique using a highly stabilized generator and a germanium detector for the in vivo determination of bone mineral content in the lumbar vertebra has been described previously from the authors laboratory. This technique estimates the bone mineral content in presence of fat and lean soft tissue in the path of the x-ray beam. The present investigation was undertaken in vitro to determine the accuracy, precision and long term reproducibility of the technique. The ash density of 12 human bone specimens was determined on the basis of ash weight and total volume measurements of each specimen. The result was compared with the measured bone mineral content. The deviation between the result of the attenuation measurements and the weight/volume measurements was (4 +/- 0.9%). The precision of the method as measured in vitro has been determined to be between +/- 1.6% (high bone mineral content) and +/- 2.6% (low bone mineral content) by repeated measurements on a new type of bone mineral phantom. The results show that the technique described gives an accuracy and a precision which is of the same order of magnitude as the technique using dual photon energy absorptiometry.

52207 (BNL—39428, pp C1) **Use of a pulsed neutron generator for in vivo measurement of body carbon.** Kehayias, J.J.; Ellis, K.J.; Cohn, S.H.; Yasumura, S. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The measurement of total body fat is of importance in studies of nutritional assessment, dietary regimens, and for the management of obesity. In the past, fat has been determined either by anthropometric methods, which introduce high uncertainties, or by model-dependent estimation of fat-free tissue. The validity, however, of the different models in disease is questionable. Total body carbon measurements provide a more direct evaluation of body fat both in normal subjects and in patients. The authors present here a facility for carbon measurements without the use of a major accelerator. The same facility can be used for the measurement of other major body elements and for the evaluation of the body's compartments. Carbon is measured in vivo through neutron inelastic scattering, by detecting the 4.44 MeV gamma rays. A miniature (10 cm long) 14 MeV D-T neutron generator is used. The short half-life of the 4.44 MeV state of carbon requires detection of the gamma rays simultaneously with the 10 μs neutron pulse. Generators with low pulsing rate were found inappropriate for carbon measurement because of their low duty-cycle (high neutron output during pulse). The detection system consists of NaI(T1) detectors and fast electronics for handling the high even rate during the neutron pulse. A

description of the facility and an evaluation of the technique will be presented.

52208 (BNL—39428, pp C2) **Lean body mass and fat: concordance and discordance.** Forbes, G.B. (Univ. of Rochester Medical Center, NY (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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This presentation will compare the changes in LBM and fat produced by various maneuvers, using data from the author's laboratory and from the literature. In certain situations these two body components change in the same direction albeit in variable proportions; in other situations they change in opposite directions. Deliberate overfeeding of normal subjects with normal diets, and rehabilitation of the undernourished produce an increase in both LBM and fat; the relative contribution of each component to the total weight gain determines the energy cost of the weight gain. Spontaneous weight gain also involves both LBM and fat. With but one exception (the hibernating bear) underfeeding results in a fall in both LBM and fat; the ratio of LBM loss to the total weight loss is directly proportional to the degree of the energy deficit and inversely proportional to the initial body fat content. Established obesity is usually associated with an increase in LBM as well as fat, anorexia nervosa with a decrease in both. Large doses of androgens cause an increase in LBM and a decrease in fat, hypothalamic injury (in animals) a decrease in LBM and increase in fat. In contrast to normal high energy diets, those which are low in protein, cause an increase in body fat without a concomitant increase - or even a decrease - in LBM. Vigorous exercise may increase body fat and increase LBM to a modest degree, while bed rest does the reverse. Thus, in some situations LBM and fat behave as true companions, in other situations as strangers.

52209 (BNL—39428, pp C4) **Noninvasive body composition in humans by near infrared spectroscopy.** Conway, J.M. (Department of Agriculture, Beltsville, MD (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Near infrared radiation was introduced into the body at the same sites as typically used for skinfold measurements, triceps, biceps, subscapular, suprailiac, and thigh. NIR penetrates approximately 1 cm., interacts with the tissue, and is scattered back to the surface where the absorbance is measured. This process is called infrared interactance (IRI). Computer assisted spectra were obtained for the five sites (log 1/I [interactance] vs wavelength). The log 1/I at each of these wavelengths for all of the five sites was correlated with body composition estimates from other methods. In the first study, data were collected from 53 adults (23 to 65 yrs). IRI correlated best with results from D_2O, r(+/-SEE) = 0.94 (3.0). Body fats of 68 adults (38M, 30F), between 20 and 61 years of age and between 4.5% and 39.9% fat were estimated by IRI, D_2O, SF, hydrostatic weighing (UWW) and total body impedance (TBI). Correlation coefficients, (r+/-SEE), were IRI:D_2O = 0.90(3.2); IRI:SF = 0.82 (3.9); IRI:UWW = 0.085 (4.3); IRI:TBI = 0.85 (3.0). In order to test the feasibility of developing a low-cost practical instrument utilizing this technology, a computer simulation was performed to compare the results from the optimized single-term, second derivative data treatment, to the results from wide-bandwidth IRI data in combination with readily available subject parameters.

52210 (BNL—39428, pp E1) **Quality of the lean body mass.** Pierson, R.N. Jr.; Wang, J. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Small sets of data are presented concerning the constituents of the lean body in several conditions and disease states, from which we have developed the concept of the quality of the lean body mass. After adipose tissue has been measured and subtracted from the body weight, and certain adjustments made to allow for the extracellular water obligated by the adipose tissue, the body potassium and sodium contents are considered. In studies where the extracellular and intracellular water are measured, and the average potassium and sodium concentrations in the intracellular water (K/sub i/ and Na/sub i/) are available, they are used to define the quality of the lean body. In a larger number of clinical studies, only body potassium and body water measurements are available, and the K/TBW is taken as surrogate for the more complete measurements. The authors will review data from their own laboratory and other which include K/sub i/ and Na/sub i/ and K/TBW, in cohorts of subjects who are normal and super-normal (athletes), and in patients with alcoholism, manic-depressive psychosis, obesity, anorexia nervosa, cardiac failure, and AIDS, which affect water and electrolyte metabolism. These data will establish the correlation of K/TBW with the K/sub i//Na/sub i/ ratio, and will provide a basis for discussion of the concept that the quality of the lean body can be defined with clinical utility in such a one-dimensioned manner.

52211 (BNL—39428, pp E2) **Measurement of total body water by isotope dilution: a primer for calculations.** Schoeller, D.A.; Jones, P.H. (Univ. of Chicago, IL (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The measurement of body water is often performed by isotope dilution using either the stable isotopes deuterium or oxygen-18 or the radioisotope tritium. Although the dilution principle itself is quite simple, the dynamic nature of water metabolism necessitates corrections for isotope losses or changes in body water that occur during the delay associated with isotope distribution across the body. If the time of the determination is defined as the time of the dose, then the amount of the isotope in the body is equal to the dose. However, because the sample is collected at some time after the dose to allow for isotope equilibration, the measured total body water must be corrected for any water entering the body pool between the time of the dose and the time of the sample. If the time of the determination is defined as the time at which the sample is taken, then the amount of isotope in the body is equal to the dose less any isotope that has left the body as either urine or insensible water.

52212 (BNL—39428, pp E3) **Hydration of fat-free mass in protein-calorie malnourished infants.** Field, C.R.; Schoeller, D.A.; Brown, K.H. (Univ. of Chicago, IL (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Total body water may be unreliable in single-point measurements of fat-free mass (FFM) in malnourished children because of hydration abnormalities. However, data on hydration of FFM are largely from cadaver analysis leaving uncertainties about body composition of children who survive and particularly about composition of weight gained during recovery. The objective was to test the hypothesis that the FFM component of weight gain (d FFM) could be measured from change in total body water (dTBW). A predictable relationship between dTBW and d protein in body mass gained would support the hypothesis. The authors further tested the hypothesis by comparing energy stored calculated from TBW with that determined by energy balance.

52213 (BNL—39428, pp E5) **Deuterium and oxygen-18 isotope dilution spaces in normal adults.** Wong, W.; Cochran, W.; Lee, L.; Klish, W.; Klein, P. (Baylor College of Medicine, Houston, TX (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

In light of the limited series of published comparison the authors have determined the deuterium and oxygen-18 isotope dilution spaces in 10 normal subjects, 5 males and 5 females. Labeled water was administered orally at doses of 40 mg deuterium oxide and 60 mg oxygen-18 per kg of body weight. One predose blood sample and six hourly postdose blood samples were collected from

each subject. Aliquots of plasma water were reduced directly to hydrogen gas with zinc shot in individual quartz reaction vessels and $^{2}H/^{1}H$ isotope ratios were determined by gas-isotope-ratio mass spectrometry (GIRMS). $^{18}O/^{16}O$ isotope ratios were determined after plasma samples were equilibrated with CO_2 in an isotope exchange system. Both ^{2}H- and ^{18}O-labeled water attained isotopic equilibrium in plasma within 3 hr after administration. The deuterium dilution spaces in males and females were 56.4 +/- 2.1% (mean +/- SD) and 55.9 +/- 0.9% of body weight, respectively, while the ^{18}O dilution spaces constituted 54.1 +/- 1.85% and 53.30 +/- 1.30%. The deuterium spaces were larger than the ^{18}O spaces by 4.55 +/- 0.56% in men and 4.78 +/- 1.63% in women and were significant at $P < 0.01$. These results compare with values of 3.81 +/- 2.66% for males ($n = 6$) and 1.10 +/- 2.67% for females ($n = 2$) previously reported by Schoeller et al.

52214 (BNL—39428, pp E6) **Body water, extracellular water, body potassium, and exchangeable sodium in body builders using anabolic steroids.** Wang, J.; Colt, E.D.W.; Pierson, R.N. Jr. (Saint Luke's Roosevelt Hospital Center, New York, NY (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Nine competitive male body builders aged 21 to 34 who were determined to take anabolic steroids were studied before and 6 to 10 weeks after a training cycle which included steroid administration. A control group of nine subjects matched in age and duration of competitive career, but using only natural training methods were studied on a single occasion while in training. Total body potassium (TBK) by ^{40}K, total body water (TBW) by $^{3}H_2O$ dilution, extracellular water (ECW) by $^{35}SO_4$ dilution and zero time extrapolation, and exchangeable sodium by ^{24}Na dilution were measured before and after training. Intracellular water (ICW) was calculated from TBW - ECW. Initially steroid users had a greater skeletal muscle mass than control subjects, and obtained a further weight gain on steroids, all in skeletal muscle, based on parallel increases in TBK and ICW. Other body composition measurements did not change significantly. A single steroid user became ill taking steroids, decreased potassium by 5%, and increased extracellular water, changes which may represent the effects of hepatic dysfunction which occurred while on anabolic steroids.

52215 (BNL—39428, pp E7) **Direct measurements of total body oxygen in body composition studies.** East, B.W.; Preston, T.; Robertson, I.; Davies, D.L.; Herd, G. (Scottish Universities Research and Reactor Centre, Glasgow (Scotland)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Since Williams and Boddy first reported in 1978 the measurement of body oxygen in vivo using the $^{16}O(n,p)^{16}N$ reaction induced by 14 MeV neutron activation, the method has been routinely applied to all TBIVNAA multielement patient analyses at SURRC. A considerable bank of data has thus been accumulated which lend itself now to detailed analysis to assess aspects of the effectiveness and applicability of the measurement. The authors have taken a selected group of 85 patients with abnormal blood pressure and used their total body oxygen to calculate total body water by compartmental means from the known oxygen stoichiometry of protein, mineral, water and fat and intercompared this with other methods for body water namely: tritium dilution and the sum of chlorine and potassium spaces. The findings are presented and discussed. In routine use the repeatability of total body water measurement by TBIVNAA has been found to be 7.8% (2 σ) and 5.1% (2 σ) for compartmental and electrolyte space analyses respectively.

52216 (BNL—39428, pp P2) **Relationship between density and body weight in prematurely born infants receiving different diets.** Dell, R.B.; Aksoy, Y.; Kashyap, S.; Forsythe, M.; Ramakrishnan, R.; Zuker, C.; Heird, W.C. (Columbia Univ., (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Body density, defined as weight/volume, is a function of total body fat, protein, bone mineral and water. If bone mineral and total body water are relatively constant over time within a subject then changes in density reflect changes in the proportion of fat to protein in the body that occur with growth. The authors determine density by weighing the infant by measuring volume utilizing a newly developed instrument (Volumeter). The principle of air displacement is used in the Volumeter to measure volume. The instrument consists of two identical plexiglas cylinders enclosed in a thermostated box with a sensitive differential manometer monitoring the pressure difference between the two cylinders.

52217 (BNL—39428, pp P3) **Neutron activation analysis technique for the measurement of phosphorus in sections of the human body.** Glaros, D.; Xatzikonstantinou, J.; Leodiou, J.; Kalef-Ezra. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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A partial-body neutron activation analysis technique has been developed for the in vivo measurement of phosphorus in skeletal sections via the ^{31}P (n a) ^{28}Al fast neutron reaction. Sections of the body's extremities were unilaterally and bilaterally irradiated using two 1,3 x 10^{11} Bq ^{241}Am-Be sources in a fixed position and also with the source oscillating over a pre-selected length of a long bone, simulating an extended source. The induced ^{28}Al activity was measured with the body section under investigation sandwiched between two NaI detectors, 28 cm diameter x 10 cm thick. Measurements on phantoms and humans showed that with radiation skin doses ranging 5-20 mSv, phosphorus can be determined with an overall reproducibility coefficient of variation of about 3%.

52218 (BNL—39428, pp P4) **Body composition in infants by dual-photon ^{153}Gd absorptiometry.** Gotfredsen, A.; Pedersen, S.; Hassager, C.; Christiansen, C. (Univ. of Copenhagen (Denmark)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The body composition (lean % and total body bone mineral, TBBM) was investigated in 60 newborn infants (on their third day of life) by dual-photon ^{153}Gd absorptiometry (DPA) and anthropometric measurements. Preliminary data on the group of the infants ($n = 31$) comprising mostly normal infants revealed significant relationship between the lean % versus the ponderal index, the skinfold thickness, and the weight, respectively. Furthermore, the authors found significant correlations between the TBBM versus the weigh and the gestational age, respectively. They failed to demonstrate a significant correlation between the lean % and the gestational age. Their final presentation will include results on the normal infants as well as those being preterm, light for date, and dysmature. It will be investigated whether the DPA measurements give a better separation between normal infants and preterm/dysmature infants than the classical clinical estimates of dysmaturity.

52219 (BNL—39428, pp P5) **In vivo measurements of nitrogen using a neutron activation technique.** Larsson, L.; Alpsten, M.; Toelli, J.; Drugge, N.; Mattsson, S. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Knowledge of body composition is essential for understanding of many diseases such as obesity, anorexia, cancer, kidney and heart diseases. For many years, total body potassium (TBK) has been used as an estimate of the intracellular protein. In some diseases intracellular- and extracellular protein may vary significantly. Together with TBK, total body nitrogen (TBN) should in these cases be measured to estimate the total protein content. The nitrogen content can be measured by in vivo neutron activation. In this work the authors have used the prompt gamma technique: Thermalized neutrons from a Cf-252-source are captured in (n, δ)-reactions. Prompt 10.8 MeV photons are emitted and can be detected during irradiation. The source is contained in a polyethylene block which

forms a collimator surrounded by a phi 1.40 m x 0.80 m water tank. The patient is irradiated from below by a 15 cm x 50 cm neutron field. It is possible to scan the whole patient or to measure a part of the body. A phi 15 cm x 15 cm NaI(T1)-detector is used for detection of the 10.8 MeV photons. The detector is mounted above the patient outside the neutron field.

52220 (BNL—39428, pp P6) **Measurements of body protein for clinical investigation.** Mernagh, J.R.; Harrison, J.E.; McNeill, M.G.; Jeejeebhoy, K.N.; Krishnan, S.S. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Body protein (nitrogen) is determined by bilaterally irradiating the body with neutrons using Pu-Be sources and measuring the resultant 10.8 MeV gamma rays from the reaction $^{14}N(n,8)\ ^{15}N$. In the authors lab the whole body can be scanned or separate segments of the body can be measured independently. A nitrogen index has been developed based on body size and is used as a predictor of normal total body nitrogen (TBN). They have found that TBN, when normalized to body size in this way, provides a reliable index of protein status which cannot be accurately determined by body weight, anthropometry, or body potassium measurements. Changes in body composition with age were studied by measuring the composition of 56 healthy female volunteers aged 20-80. Measurements were made for K(^{40}K), Ca and N. It was shown that protein and bone mineral decrease with age but that this is not reflected in K or anthropometry measurements. Results of other studies to be presented include: body protein measurements pre and post TPN (total parenteral nutrition), nutritional status of patients on long term CAPD (continuous ambulatory peritoneal dialysis) and changes in body composition as a result of TPN in patients with small cell lung cancer receiving chemotherapy. Clinical results show that indirect measurements of body protein based on weight, potassium, or anthropometry, do not give an accurate measure of body protein. For an accurate measurement, direct measurement of body protein is necessary.

52221 (BNL—39428, pp P14) **Body composition studies in aging rats.** Yasumura, S.; Kiebzak, G.M.; Ellis, K.J.; LoMonte, A.F.; Zhang, R.; Yuen, K.; Cohn, S.H. (SUNY-Health Science Center, Brooklyn, NY (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Several parameters of body composition were measured in female rats 6, 12, and 24 months of age. Total body calcium (TBCa), sodium (TBNa), and chloride (TBCl) were determined by neutron activation; total body potassium (TBK) was measured by ^{40}K counting; and total body water (TBW) was measured by isotope (HTO) dilution. In addition to these measured values, the authors present derived values for extracellular water (ECW), intracellular water (ICW), intracellular potassium concentration (ICK), and total body fat. ECW is derived from the TBCl and plasma chloride concentration, and ICW = TBW - ECW. The intracellular potassium: ICK = TBK/ICW; and body fat is derived from BW - lean body mass (LBM) where the LBM is derived from a combination of TBK, TBCa, and ECW. Mean body weights were 327, 381 and 383 g in the 6-, 12-, and 24-month-old rats, respectively. There was a concomitant increase in TBW with age so the TBW:BW ratio remained constant and averaged .64 +/- .04 for all rats in the study. However, the distribution of water was altered; the ECW:TBW ratio increased from .41 to .47 with age. The absolute amounts of ICW and TBK were similar for all age groups; thus, the intracellular potassium concentration remained unchanged and averaged 153.8 +/- 15.5 mEq K/liter ICW. Like the TBK, the TBCa also remained unchanged, the difference in weight was presumed to be body fat. Using the equation Fat = BW - LBM, they calculated the fat as a percent of BW: 11%, 19%, and 21% for the three age groups, respectively.

52222 (BNL—39428, pp P17) **Pre-reconstruction dual-energy, X-ray computerized tomography (CT): theory, implementation, results, and clinical use.** Oravez, W.T. (Siemens Medical Systems, Inc., Iselin, NJ (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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For the task of bone mineral measurement, single-energy quantitative CT has demonstrated its worth in terms of precision for most longitudinal clinical studies. However, for cross-sectional clinical studies, known inaccuracy exists due to less than robust beam-hardening corrections, and negatively biased bone mineral measurement, due to the effect of unknown variable concentration of bone marrow fat within the metabolically active trabecular bone space. A dual-energy measurement technique provides a solution to these deficiencies of single-energy measurements. The fundamental theory of dual-energy measurement techniques is based on a Compton-photoelectric approximation and the mixture rule for the total attenuation coefficient. Resolution of atomic composition and electron density components of attenuation should then be possible. To take full advantage of these principles, the raw dual-energy projection values are operated on before reconstruction. This method beam-hardening and composition-selective imaging. Rapid kilovoltage switching between projection measurements, rather than serial measurements, assures the best measurement quality.

52223 (BNL—39428, pp P19) **Cyproterone acetate, an alternative gestagen in postmenopausal estrogen/gestagen therapy.** Riis, B.J.; Jensen, J.; Christiansen, C. (Univ. of Copenhagen, Glostrup (Denmark)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Seventy six healthy, early postmenopausal women (aged 45-54 years) were allocated to 2 years of treatment with a cyclic combination of 2 mg estradiol valerate (21 days) and 1 mg cyproterone acetate (11 days) or placebo. Sixty five women (86%) completed the study. In the hormone treated group there was a significant decrease in biochemical estimates of bone turnover (serum alkaline phosphatase, serum phosphate, fasting urinary calcium and hydroxyproline), whereas these values were unchanged placebo treated group. In the placebo group the bone mineral content in the forearms (measured by single photon absorptiometry) and the bone mineral content in the lumbar spine and in the total skeleton (measured by dual photon absorptiometry) decreased significantly and at the same magnitude ($p < 0.001$), whereas all bone mass measurements remained unchanged in the hormone treated group. From the present study it can be concluded that treatment with a cyclic combination of 2 mg estradiol valerate and 1 mg cyproterone acetate is effective as prophylaxis in postmenopausal osteoporosis.

52224 (BNL—39428, pp P20) **Calcium requirement and factors influencing the skeletal status in man.** Spencer, H. (V.A. Hospital, Hines, IL (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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In view of the high incidence of bone loss with aging, particularly in females, the maintenance of the integrity of the skeletal status with age is of utmost importance. In addition to hormonal deficiency multiple factors may play a role in the development of skeletal demineralization. The effect of certain dietary factors such as calcium, phosphorus and protein, as well as the effect of several drugs was investigated on mineral metabolism. In studies of the calcium requirement, the amount of calcium needed to achieve calcium equilibrium or a positive balance was determined. Increasing the phosphorus intake by a factor of 2.5 led to a decrease in urinary calcium irrespective of the calcium intake; there was no adverse effect on the calcium balance nor on the intestinal absorption of calcium. A high protein intake, given as meat, did not affect urinary or fecal calcium nor the calcium balance in contrast to the effect of purified proteins which induce an increase in urinary calcium and calcium loss. Several drugs such as aluminum-containing

antacids, certain diuretics, certain antibiotics, corticosteroids and antituberculosis drugs and thyroid medications induced a distinct increase in urinary calcium and some of these also caused fecal calcium loss. Advanced osteoporosis has been observed in the authors patients who have consumed excess alcohol for prolonged periods of time. In view of the widespread use of alcohol and of the drugs mentioned above their long-term use singly or combined would be expected to lead to calcium loss and would thereby increase the calcium requirement.

52225 (BNL—39428, pp P21) **Carbonated beverage consumption and bone fractures.** Wyshak, G.; Frisch, R.E.; Albright, N.L.; Albright, T.E.; Schiff, I.; Witschi, J. (Harvard Center for Population Studies, Cambridge, MA (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Data are presented on an association between the consumption of non-alcoholic carbonated beverages and the occurrence of bone fractures among 5398 college alumnae, 2622 former college athletes and 2776 non-athletes, ranging in age from 21 to 80 yr. There has been a 300% increase in the intake of carbonated beverages in the US in the last three decades, and an accompanying decline in milk consumption. Relative risk (RR) was evaluated: 1) among all alumnae up to age 50 for the association between consumption of carbonated beverages and for any bone fracture occurring at or after 22 yr; and b) among all alumnae at or after age 50 for any bone fracture occurring at or after age 40. Among alumnae under age 50, consumers had a significantly higher risk of fractures; RR was 1.33, 95% CL (1.06, 1.65). For alumnae age 50 yr and over, only the former college athletes had a significant association between carbonated beverage consumption and bone fractures. The RR was 1.63, 95% CL (1.05, 2.53). The RR for the association of drinking carbonated beverages and a first fracture occurring at or after age 40 among former college athletes was more than twice as high for drinkers of carbonated beverages as for non-drinkers: RR was 2.28, 95% CL (1.15, 4.53). An altered calcium-phosphorus ratio may contribute to the increased risk of fractures.

52226 (BNL—39428, pp P30) **Estimation of total body potassium in the presence of interfering radio isotopes.** Lykken, G.I.; Speaker, K.K.; MacKichian, A.K. (Univ. of North Dakota, Grand Forks (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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A whole body counter employing a 32 4" x 4" x 16" single-crystal NaI(T1) detectors has been assembled and used to monitor total body potassium-40 (TBK-40) emissions from subjects participating in mineral bioavailability studies. The system calibration has been performed daily by counting 4 Na-22 sources and having a computer-controlled power supply set the voltage on each photomultiplier tube so that the centroid of the 1.275 MeV photopeak, observed by each detector, occurred at a designated channel in the computer-based multichannel pulse height analyzer. The total net Na-22 counts from the 32 detectors has been recorded as a stability check, and when the ln of the daily total count was plotted as a function of time, a straight line was observed ($r = 0.998$) with a slope of -0.00072 d^{-1} +/- 0.000004 d^{-1}. This system has been designed to estimate corrected gamma ray activity, independent of radionuclide distribution and body size, and to use matrix inversion to estimate activities from a number of isotopes having overlapping gamma ray spectra.

52227 (BNL—39428, pp P31) **Total body water measurement by isotopic water in very young animals.** Sheng, H.P.; Wong, W.; Garza, C.; Klein, P. (Baylor College of Medicine, Houston, TX (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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An accurate estimate of total body water (TBW) using isotopically-labeled water is necessary for in vivo body composition studies. Studies of animals at various physiological ages indicate that the volume of distribution of tritiated or deuterated water may be significantly larger than the volume of TBW measured by desiccation. This overestimation may be as large as 15% of body weight in young growing animals. Although oxygen-18 has been used to measure TBW in human infants and adults, the accuracy of the measurement in the growing animal has not yet been determined. The authors evaluated the volumes of distribution of ^{18}O and tritiated water as measures of TBW in the infant minipig. Four minipigs, 9 to 12 days old were studied. Total body water was calculated from the volumes of distribution of ^{18}O and ^{3}H. Both tracers were administered simultaneously into the jugular vein and the plasma enrichment of ^{18}O and specific activity of ^{3}H were measured on the 2-, 3-, and 4-hr post-dose plasma samples. Total body water calculated from ^{18}O and ^{3}H was compared with TBW obtained by desiccation. Total body water measured by desiccation was 70.2 +/- 1.47%. ^{3}H- and ^{18}O-labeled water overestimated TBW measured by desiccation by 2.9% and 8.3%, respectively. The overestimations were significant at $P < 0.05$. Their initial results suggest that water labeled either with ^{3}H or ^{18}O overestimates the total physical body water in the young growing animal.

52228 (BNL—39428, pp P32) **Comparison of total body water determinations in lactating women by anthropometry, water displacement, and deuterium isotope dilution.** Wong, W.; Butte, N.; Lee, L.; Garza, C.; Klein, P. (Baylor College of Medicine, Houston, TX (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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To expand the limited data on the total body water in lactating women, the authors have determined total body water contents, in eight subjects from anthropometric measurements, water displacement, and isotope dilution of deuterium oxide. On the day of the study, their skinfold thicknesses were measured over the biceps and triceps muscles and at the suprailiac and subscapular areas. Their body densities were measured by water displacement. Deuterium oxide was administered orally at 100 mg/kg of body weight. One predose milk sample was collected from each subject. The milk samples were defatted by centrifugation and the milk water was reduced to hydrogen gas for hydrogen isotope ratio measurements by gas-isotope-ratio mass spectrometry. The results indicated that total body water in lactating women estimated from anthropometric measurements was 49.7 +/- 3.3% of body weight, by water displacement was 54.9 +/- 7.2%, and by isotope dilution was 50.8 +/- 3.7%.

52229 (BNL—39428, pp P34) **Experience with bioelectrical impedance determinations in young children: sources of variability.** Barillas, C.; Vettorazzi, C.; Molina, S.; Pineda, O. (Center for Studies of Sensory Impairment, Aging and Metabolism of the National Committee for the Blind and Deaf of Guatemala, Guatemala City). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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The biochemical impedance analysis (BIA) technique for the estimation of body composition could have wide application in children, but before it can be effectively used, factors that alter the measurements have to be evaluated. Using a BIA-101 instrument, the authors studied the effects of: a) inter-electrode distance and b) electrode placement on the measurements of resistance (R). In adults, sensor electrodes are conventionally placed over the dorsal wrist and dorsal ankle, with signal electrodes placed at the proximal end of the metacarpals and metatarsals, respectively. Given that children's hands and feet are smaller, they were concerned about interaction between the two electrodes on the same extremity. Close approximation of electrodes is known to increase the R value artifactually. The technique is discussed which allows a prediction of impedance readings taking advantage of the maximum conduction volume. In the young child, certain specific modification in the BIA technique are required to get the most stable, reproducible and artifact-free measurements.

52230 (BNL—39428, pp P35) **Segmental bioelectric impedance measure of body composition.** Chumlea, W.C.; Baumgartner, R.N.; Roche, A.F. (Wright State Univ. School of Medicine, Yellow Springs, OH (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Bioelectric impedance is measured conventionally as the resistance (R) to the flow of a small alternating current in the body through the right foot to the right hand. Stature (S) squared divided by resistance (S^2/R) as measured from the foot to the hand, has been used to estimate total body water (TBW) and lean body mass (LBM) with high correlations. However, direct estimation of these components of body composition from bioelectric impedance is inherently inaccurate. S^2/R provides a partial measurement of total body volume based upon resistance for the right leg, the trunk and the right arm only, and stature is not a true measurement of the length of the conductor. This may limit the accuracy of the estimation of TBW or LBM. Moreover, the volume resistivity (p) of the body has been ignored in most studies.

52231 (BNL—39428, pp P36) **Use of total body electrical conductivity (TOBEC) to determine total body water.** Cochran, W.; Wong, W.; Sheng, H.P.; Klein, P.; Klish, W. (Baylor College of Medicine, Houston, TX (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Total body electrical conductivity (TOBEC) has been introduced as a safe and rapid method to estimate body composition in infants and adults. Recently, a second generation instrument that operates in a scanning mode has been developed. A study was undertaken to calibrate this new instrument and to assess the feasibility of its use in estimating total body water. Six healthy adults, 3 males and 3 females, ranging in age from 25 to 57 years, and in weight from 43.3 to 104.7 kg were analyzed. Simultaneously, determinations of total body water were made by standard dilutional techniques using $H_2{}^{18}O$. A baseline plasma sample was obtained and 60 mg ^{18}O/kg was given orally as $H_2{}^{18}O$. Five hr later, a post-dose plasma sample was obtained. The $^{18}O/^{16}O$ ratio in the plasma samples was determined as CO_2 by gas-isotope-ratio mass spectrometry and used to calculate the $H_2{}^{18}O$ volume of distribution. The total body water values ranged from 26.35 to 58.02 and represented 51 to 58% of body weight. There was good linear correlation between the total body water measurement and its phase average (TOBEC number) with a linear correlation coefficient of 0.998. The standard error of the estimate was 0.98. In addition to estimating fat and fat-free mass, the TOBEC method also estimates total body water with excellent correlation to physical dilutions methods.

52232 (BNL—39428, pp P37) **Evaluation of total body electrical conductivity (TOBEC) measurements for the determination of body composition in the human infant.** Fiorotto, M.; Cochran, W.; Sheng, H.P.; Klish, W. (Baylor College of Medicine, Houston, TX (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Most techniques used for routine measurement of fat and fat-free mass (FFM) of adults are not suitable for use in infants. The TOBEC instrument, with the appropriate calibration, may provide an alternative that is safe, noninvasive, and accurate. The infant miniature pig was selected as a model because it is similar in size and composition to the human infant. The animals were analyzed for total body water (TBW), fat, and electrolyte contents by chemical analysis. Plasma was obtained, and water and electrolyte concentrations were measured. FFM, intra- and extracellular fluid volumes were calculated. TOBEC values were highly correlated with both TBW and FFM. The predictive accuracy was improved by accounting for age-related changes in compartmental volumes and electrolyte composition. The calibration derived for the infant mini-pigs was then evaluated by estimating the FFM and fat of 20 healthy infants between (age, 2 to 12 wk) from their individual TOBEC measurements.

52233 (BNL—39428, pp P38) **Validation of the total body electric conductivity method by direct carcass analysis of swine.** Keim, N.L.; Taylor, S.J.; Mayclin, P.L.; Brown, D.L. (Department of Agriculture, San Francisco, CA (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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In vivo determination of body composition by measuring total body electric conductivity (TOBEC) is based on the principle that lean and fat tissues differ in conductive and dielectric properties. To date, only indirect measurements of human body composition have been used to validate the TOBEC instrument, Model HA-2. In this study, direct chemical carcass analysis of pigs was used to examine relationships between TOBEC and body water (W), lean mass (LM) and fat mass (FM). Twenty-five pigs were selected with body weights and estimated compositions comparable to human adults. For TOBEC measurement, animals were anesthetized, transferred to the HA-2 sled and scanned. On the following day, pigs were slaughtered and partitioned into carcass, viscera, blood and ingesta compartments. Proximate analysis of compartment samples was used to determine total content of W, LM, and FM.

52234 (BNL—39428, pp P39) **Feasibility study of in vivo body composition measurements using a resonant A.C. circuit.** Saunders, N.H.; Rassi, D.; Chadwick, P.; Dutton, J.; Sivyer, A.; Morgan, W.D. (Univ. College of Swansea (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The present experimental system consists of a single layer solenoid connected in parallel with a variable tuning capacitor and driven, via a power amplifier, by a radio frequency sweep oscillator. The resonance peak is displayed on an oscilloscope which monitors the coil current and whose time-base ramp signal is used to sweep the oscillator through the resonant frequency at the circuit. The technique is being applied to non-biological conductors and present studies involve the extension of the method to conductivity measurements on limbs and eventually the whole human body. A whole body conductivity measurement can be used to estimate the relative volume of conductive tissue, and hence of non-conducting fat, simple and inexpensively. There are, however, questions concerning the influence of obesity and other factors on the method and since the authors have available to them both whole body ^{40}K or neutron activation measurements, it is intended to carry out an intercomparison of the methods.

52235 (BNL—39428, pp P40) **Sources of variability in bioelectrical impedance determinations in adults.** Elsen, R.; Siu, M.L.; Pineda, O.; Solomons, N. (Center for Studies of Sensory Impairment, Aging and Metabolism of the National Committee for the Blind and Deaf of Guatemala, Guatemala City). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Although the bioelectrical impedance analysis (BIA) technique for determining body composition is straight-forward, rapid and non-invasive, it does not follow that its application is not without limitations, pitfalls and caveats. The authors undertook studies to define the precision, reproducibility, and detection limits for changes in the BIA indices. Studies were conducted using a BIA-103 or BIA-101 instrument. In a study to determine inter-observer correlation, 10 subjects were measured for resistance (R) and reactance (Xc) by two experienced operators independently; once with only the anatomical references; and again with marks on the skin indicating the agreed upon positions. To put all of the findings into perspective, the instrumental error the apparati is 1.0%, meaning that a R reading of 500 ohms is really between 495 and 505 ohms. To determine the acute change in hydration that is detectable by the BIA technique, subjects were given progressive increments of 250 ml of an electrolytic solution with 110 mEq/L of cations up to one liter. Contrary to expectations, the salt solution produced no changes in R or Xc distinct from that with pure water in equal vol-

umes, or from serial monitoring alone. Apparently, in the well-hydrated individual, oral electrolytes and water do not rapidly incorporate into a body-water pool recognized by the BIA technique.

52236 (BNL—39428, pp P41) **Accuracy and precision of bioelectrical impedance and anthropometry to estimate body composition.** Gonzalez-Cossio, T.; Diaz, E.; Delgado, H. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

With the aim of comparing estimates of body composition obtained through under-water weighing (UWW), bioelectrical impedance (BEI) and anthropometry (ANT), the authors determined body composition of 26 Guatemalan adult INCAP employees using these three methodologies. The study group consisted of 8 male and 16 female apparently healthy volunteers with a mean age of 27.8 yrs. Mean (+/- SD) weight was 58.4 (8.2) Kg and height 161.9 (9.3) cm. Body fat (BF) and fat-free mass (FFM) estimates were derived using Siri, Durnin and Womersley, and RJL system equations for UWW, ANT an BEI respectively. Percent fat as estimated by UWW ranged from 11 to 34.9. It was estimated by computing the percent body fat for each measurement and comparing group means by paired t-tests of the first vs the second measurement day. t-values were for UWW = 0.32 ($p = 75$), BEI = -0.72 ($p = 48$) and ANT = -0.02 ($p = 98$) with correlation coefficients of 0.93, 0.98, and 0.99 respectively. For the accuracy analysis, BF and FFM estimates obtained by UWW were used as reference for comparing BEI and ANT estimates. On the average, BEI and ANT underestimate percent fat by 5.5 and 4.3 respectively.

52237 (BNL—39428, pp P42) **Body composition determinations by bioelectrical impedance in olympic-class athletes at the Third Central American Games.** Guzman, M.J.; Elsen, R.; Padilla, A.; Solomons, N.W.; Whalen, C.; Siu, M.L.; Mazariegos, M.; Molina, S.; Neufeld, L.; Rosas, A. (Center for Studies of Sensory Impairment, Aging and Metabolism of the National Committee for the Blind and Deaf of Guatemala, Guatemala City). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

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Relationships of body composition to athletic performance are poorly understood, in part due to limitations in ways of determining body fat and body water. The authors studied 452 individuals at the III Central American Games, using the BIA-103 instrument and calculating with RJL software nomogram on an Epson computer. Subjects were studied between 8 a.m. and 6 p.m., both in the fasting and the non-fasting state. The resistance (R) readings ranged from 317 to 787 ohms, with the expected trend to greater R values in women as compared to men. Reactance (Xc) ranged from 26 to 106 ohms for the whole group, with a parallel shift toward higher values for women athletes. Percent body mass as water (%TBW) ranged from 49 to 85% in men and from 42 to 73% in women. Percent total body mass as fat (%TBF) ranged from 1 to 33% in men and from 4 to 53% in women. If they accept 15%, as the expected average of %TBF for non-trained adult men, then 128 of 280 were at or below this level. Using 27% as the anticipated %TBF for women, they found 146 of 164 with this or a lesser fat content.

52238 (BNL—39428, pp P43) **Evaluation through sequential determination of the stability of bioelectrical impedance measurements for body composition analysis.** Siu, M.L.; Elsen, R.; Mazariegos, M.; Solomons, N.; Pineda, O. (Center for Studies of Sensory Impairment, Aging and Metabolism of the National Committee for the Blind and Deaf of Guatemala, Guatemala City). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The bioelectrical impedance analysis (BIA) technique offers a non-invasive, in vivo approach to determining human body composition. The limits of detection for real changes in body composition, such as short-term changes in hydration or longer-term changes in fat-mass or lean-body mass, will inherently depend on the stability of the measurements of impedance (Z) over time. In the present study, the authors sought to determine the interval variation in the readings of the vector components of impedance -- resistance (R) and reactance (Xc) -- over time in short-term studies and in longer-term studies. Two impedance plethysmographs, a BIA-101 junior and a BIA-103, were used. Subjects included 11 blind elders in a rehabilitation center (age range: 61-85 y) and 28 healthy women, ranging in age from 21 to 85 y: 12 were still menstruating and 9 were postfertile. The coefficients of variation ranged from 2.2 to 4.9% for the elders; one subject had a 119 ohm individual high-low difference in R. In the adult female population, c.v.'s ranged from 1.3 to 4.3% during the month of monitoring. Differences in day-to-day variance between the two subgroups of women were not detected. The present study, delineates the intrinsic variability within subjects for short and longer-term periods using the BIA technique for body composition.

52239 (BNL—39428, pp P44) **Relationship between weight-for-height index and body composition in Chilean adults.** Vasquez, M.; Pena, J.; Diaz, E. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Frequently, the weight-for-height index (W/H), the ratio between observed weight and that expected according to actual height, is used as the unique tool to assess adult nutritional status in developing countries. Expected weight is obtained from USA standards that have been developed with semi-biological or statistical criteria. With the aim of studying the relationship between W/H index and body composition (BC), 81 healthy Chilean men with ages ranging from 17 to 40 years, were assessed by W/H using 4 standards available from USA. These were compared to estimates of BC by densitometry. Mean W/H using Metropolitan Life Insurance (MLI) 1959, ICNND 1963, NCHS 1979 and MLI 1983 were: 106.8 +/- 12.5; 101.1 +/- 11.8; 104.5 +/- 12.8; and 94.5 +/- 10.8 respectively. W/H index was classified: as normal 90-110%, lean < 90%, overweight 111-120%, and obese > 120%. BC was normal when body fat was between 10-20% of body weight, lean < 10%, and excess > 20%. It was found that only a 27% of cases were classified in the same category of adequacy by both W/H and BC. By regression analysis W/H explains no more than 39% of body-fat variance, with a mean error of estimation of 3.3 kg. In conclusion, irrespective of the standard, W/H indices are not related with body composition.

52240 (DOE/ER/13424—2) **Development of methods for the structural characterization of complex carbohydrates: Progress report for the period July 1986--July 1988.** Albersheim, P. (Georgia Univ., Athens (USA). Complex Carbohydrate Research Center). Jul 1988. Contract FG09-85ER13424. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016142/JAW.

The characterization of complex carbohydrates is being studied. The following areas of research are described: A sensitive and exceptionally facile assay for reducing sugars based on the formation of a compound that fluoresces. We have used the fluorescence assay to purify to homogeneity an enzyme obtained from pea stems that is able to modify an oligosaccharide fragment of xyloglucan that inhibits auxin-stimulated growth of pea stems; the use of the most sophisticated two-dimensional NMR techniques to simplify the analysis of the oligosaccharides generated from cell wall polysaccharides by treatment of the polysaccharides with endo-glycanases; the use of the most recently developed liquid chromatography techniques to rapidly identify very small amounts of endo-glycanase-produced wall polysaccharide fragments from their elution "fingerprints" or "profiles"; synthesis of derivatives of oligosaccharides that can simultaneously be used to increase their electron avidity in order to enhance their ability to be analyzed by mass spectrometry and to endow the oligosaccharides with a chromophore that can be readily detected in liquid chromatography effluents. Proposed research is also discussed.

52241 (INIS-mf—11309, pp 168) **Nuclear magnetic relaxation dispersion measurement of the dimerization of HEW lysozyme.** Raeymaekers, H.H.; Verbeken, A.; Eisendrath, H.; Vanhaverbeke, Y.; Muller, R. (Universite Libre de Bruxelles (Belgium); Mons Univ. (Belgium)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52242 (INIS-mf—11309, pp 166) **On the molecular dynamic of nucleosides and nucleotides.** Konrat, R.; Sterk, H. (Graz Univ. (Austria). Inst. fuer Organische Chemie). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52243 (INIS-mf—11309, pp 149-150) **One and two-dimensional NMR studies of lysergic acid peptides.** Kindric, J.; Macura, S.; Sterk, H. (Boris Kindric Institute of Chemistry, Ljubljana (Yugoslavia); Faculty of Sciences, Institute of Physical Chemistry, Beograd (Yugoslavia); Graz Univ. (Austria). Inst. fuer Organische Chemie). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52244 (INIS-mf—11309, pp 112) **Some interesting dynamic properties of crystalline penicillins by variable temperature CP/MAS NMR.** Twyman, J.M.; Dobson, C.M. (Oxford Univ. (UK). Inorganic Chemistry Lab.). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52245 (INIS-mf—11309, pp 98-99) **Backbone fluctuations of proteins and polypeptides as seen by solid-state-NMR techniques: proton field-cycling NMR and deuteron-NMR.** Nusser, W.; Kimmich, R.; Winter, F. (Ulm Univ. (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52246 (INIS-mf—11309, pp 170) **Secondary structure analysis of the initiation factor of the protein biosynthesis of E. Coli IF1 by 2D NMR.** Paci, M.; Boelens, R.; Kaptein, R.; Pon, C.L.; Gualerzi, C. (Rome Univ. (Italy); Rijksuniversiteit Utrecht (Netherlands); Max-Planck-Institut fuer Molekulare Genetik, Berlin (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52247 (INIS-mf—11309, pp 87) **Refinement of the three-dimensional solution structure of barley serine proteinase inhibitor 2 using stereospecific assignment.** Hengyi, S.; Kjaer, M.; Poulsen, F.M.; Soerensen, O.W. (Carlsberg Lab., Copenhagen (Denmark); Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52248 (INIS-mf—11309, pp 85-86) **Structural investigations of head activator by one- and two-dimensional /sup 1/H-NMR spectroscopy.** Saffrich, R.; Kalbitzer, H.R.; Schaller, H.C.; Postma, J. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52249 (INIS-mf—11309, pp 84) **Structural studies of the O-antigenic polysaccharide of Escherichia coli 0,86, with blood group B activity.** Andersson, M.; Carlin, N.; Leontein, K.; Lindquist, U.; Slettengren, K. (National Bacteriological Laboratory, Department of Vaccine Development and Production, Stockholm (Sweden)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52250 (INIS-mf—11309, pp 83) **Proton NMR of the P21.GDP.MG/sup 2+/ complex of the HA-RAS oncogene product.** Schlichting, I.; John, J.; Wittinghofer, A.; Roesch, P. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52251 (INIS-mf—11309, pp 82) **/sup 1/H-NMR of the rop protein.** Eberle, W.; Kingswell, A.; Cesareni, G.; Roesch, P. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52252 (INIS-mf—11309, pp 81) **Sequence specific /sup 1/H NMR assignment and secondary structure determination of a 124 residue 'large' protein.** Ludvigsen, S.; Poulsen, F.M. (Carlsberg Lab., Copenhagen (Denmark)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52253 (INIS-mf—11309, pp 80) **3D-NMR of proteins in solution.** Oschkinat, H.; Kraulis, P.J.; Cieslar, C.; Gronenborn, A.M.; Clore, G.M. (Max-Planck-Institut fuer Biochemie, Muenchen (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52254 (INIS-mf—11309, pp 78-79) **Vancomycin and vancomycin-D-Ala-D-Ala structures: an integrated approach employing 2D NMR and energy minimisation with distance constraints.** Lian, Lu-Yun; Hawkes, G.; Molinari, H.; Sales, K. (Leicester Univ. (UK); Queen Mary Coll., London (UK). Dept. of Chemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52255 (INIS-mf—11309, pp 77) **Eremomycin - a novel glycopeptide antibiotic. The use of dipolar interactions.** Batta, G.; Koever, K.E.; Berdnikova, T.F.; Sztaricskai, F. (L. Kossuth University, Debrecen (Hungary); Biogal Pharmaceutical Works, Debrecen (Hungary); Soviet Academy of Medical Sciences, Institute of New Antibiotics Moscow (USSR); Antibiotic Research Group of the Hungarian Academy of Sciences, Debrecen (Hungary)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52256 (INIS-mf—11309, pp 76) **Structure confirmation of the active part of haemophilus influenza type b vaccine.** Mellema, J.R.; Wagenaars, G.N.; Funke, C.W.; Jacobs, P.L.; Boeckel, C.A.A. van; Boom, J.H. van; Hoogerhout, P. (Organon International B.V., Scientific Development Group, Oss (Netherlands); Rijksuniversiteit Leiden (Netherlands)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52257 (INIS-mf—11309, pp 75) **H1 two-dimensional NMR techniques as applied to globular proteins- ribonuclease A, phospholipase A/sub 2/ and dihydrofolate reductase.** Arnold, J.R.P.; Fisher, J.; Lian, L.Y. (Leicester Univ. (UK)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52258 (INIS-mf—11309, pp 73-74) **ROESY experiment. Application to the solution conformation of the synthetic tubulin fragment ac-tubulin alpha (430-441)-amide.** Otter, A.; Kotovych, G. (Alberta Univ., Edmonton (Canada). Dept. of Chemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52259 (INIS-mf—11309, pp 71) **Conformational analysis of a cyclic all-L-hexapeptide.** Hofmann, M.; Gehrke, M.; Kessler, H.; Bermel, W. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Organische Chemie; Bruker Analytische Messtechnik GmbH, Rheinstetten (Germany, F.R.)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52260 (INIS-mf—11309, pp 70) **Three-dimensional structure of acyl carrier protein in solution determined by nuclear magnetic resonance and a combined use of molecular mechanics, molecular dynamics and distance geometry.** Holak, T.A.; Nilges, M.; Gronenborn, A.M.; Clore, G.M.; Prestegard, J.H. (Max-Planck-Institut fuer Biochemie, Muenchen (Germany, F.R.); Yale Univ., New Haven, CT (USA). Dept. of Chemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52261 (INIS-mf—11309, pp 164) **ESR investigation of the core-surface relationship in the low density lipoproteins.** Brnjas-Kraljevic, J.; Pifat, G.; Herak, J.N.; Kipping, G. (Zagreb Univ. (Yugoslavia); Graz Univ. (Austria)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52262 (INIS-mf—11309, pp 66) **/sup 1/H NMR studies of protein folding.** Bogusky, M.J.; Dobson, C.M. (Oxford Univ. (UK). Inorganic Chemistry Lab.). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52263 (INIS-mf—11309, pp 65) **Toward a computer assisted analysis of NOESY spectra: a multivariate pattern recognition analysis of DNA and RNA NOESY spectra.** Grahn, H.; Roggenbuck, M.; Borer, P.; Delaglio, F.; Edlund, U. (Syracuse Univ., NY (USA); New Methods Research, INC., Syracuse, New York (USA); Umeaa Univ. (Sweden)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52264 (INIS-mf—11309, pp 55) **Interproton distances in proteins from NMR cross-relaxation in laboratory and rotating frame.** Fejzo, J.; Zolnai, Z.; Macura, S.; Markley, J.L. (Belgrade Univ. (Yugoslavia); Wisconsin Univ., Madison (USA). Dept. of Biochemistry). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52265 (IZ—8601, pp 69-72) **Study on selective concentration of proton ion by light energy.** Toda, Kiyoshi; Yabe, Isamu; Matsuoka, Hiroshi. (Inst. of Applied Microbiology, Univ. of Tokyo, Tokyo, Japan). 20 Aug 1986. (In Japanese). NTIS (US Sales Only), PC A04/MF A01 - Available from Iwatani Naoji Kinen Zaidan, 2-10-2, Nagatacho, Chiyoda-ku, Tokyo.

In FY 1985 Annual Report of the Iwatani Naoji Foundation.

Changes of pH in the inner and outer liquids of the liposome in membrane in which baceriorhodopsin (BR) was incorporated were studied, and the proton pump function was investigated. Pyranine (1-3-6 pyrenetrisulfonate) was used to monitor the pH of liposome outer liquids. A model was introduced to separately evaluate BR's proton pump function and proton leak rate from liposome. Further, analysis result of the transport process of proton by this model is reported. The accuracy of pH measurement of liposome was estimated with fluorescent probe of pyranine. Using calibration chart prepared with the standard pyranine solutions of known pH, pH values were found to be monitored within the deviation of 0.011 pH unit. Model equations of proton transport were developed in which consideration was given to BR's proton pump function and proton leaks. (6 figs, 3 refs)

52266 **Characterization of the pH-induced fusion of liposomes with the plasma membrane of rye protoplasts.** Arvinte , T.; Steponkus, P.L. (Cornell Univ., Ithaca, NY (USA)). *Biochemistry;* 27: No. 15, 5671-5677(26 Jul 1988). Contract FG02-84ER13214.

The authors present evidence that at acidic pH, liposomes composed of soybean lipids fuse with the plasma membrane of protoplasts isolated from rye leaves. Using the resonance energy transfer assay (RET), they determined the rate and extent of liposome and protoplast plasma membrane lipid mixing. The fluorescent donor-acceptor pair was N-(7-nitro-2,1,3-benzoxadiazol-4-yl)phosphatidyl-ethanolamine (N-NBD-PE) and N-(lissamine rhodamine B sulfonyl)phosphatidylethanolamine (N-Rh-PE). Fusion was substantial below pH 5, and the half-time of lipid mixing was fast (t/sub 1/2/ on the order of minutes) and pH, concentration, and temperature dependent. The extent of liposome and protoplast fusion from the total amount of liposomes associated with the protoplasts was also determined by the RET assay. Protoplasts were incubated with fluorescent-labeled liposomes (5 min at 30°C) at different pH values and then washed twice by centrifugation. The fluorescence spectra of the protoplast suspension permitted determination of the ratio of N-NBD-PE emission at 530 nm to the N-Rh-PE emission at 590 nm, which is a measure of the degree of lipid

mixing. The amount of liposomes associated (fused and unfused) with protoplasts at pH 3.9 was approximately 9 times greater than that at pH 5.6. The transfer of liposome contents to the protoplast interior was studied with a method based on the fluorescence enhancement of a solution of calcein, initially confined in the liposomes at self-quenching concentrations. The kinetics of calcein release were very similar to those of lipid mixing. Fluorescence microscopy showed that after fusion with liposomes containing calcein, the protoplasts exhibited a strong diffuse fluorescence in the interior.

52267 **Manganese peroxidase from the basidiomycete Phanerochaete chrysosporium: spectral characterization of the oxidized states and the catalytic cycle.** Wariishi, H.; Akileswaran, L.; Gold, M.H. (Oregon Graduate Center, Beaverton (USA)). *Biochemistry;* 27: No. 14, 5365-5370(12 Jul 1988). Contract FG06-86ER13550.

Manganese peroxidase (MnP), an extracellular heme enzyme from the lignin-degrading fungus Phanerochaete chrysosporium, catalyzes the Mn(II)-dependent oxidation of a variety of phenols. Herein, the authors spectroscopically characterize the oxidized states of MnP compounds I, II, and III and clarify the role of Mn in the catalytic cycle of the enzyme. Addition of 1 equiv of H_2O_2 to the native ferric enzyme yields compound I, characterized by absorption maxima at 407, 558, 605, and 650 nm. Addition of 2 or 250 equiv of H_2O_2 to the native enzyme yields compound II or III, respectively, identified by absorption maxima at 420, 528, and 555 nm or at 417, 545, and 579 nm, respectively. These characteristics are very similar to those of horseradish peroxidase (HRP) and lignin peroxidase (LiP) compounds I, II, and III. Addition of 1 equiv of either Mn(II), ferrocyanide, or a variety of phenols to MnP compound I rapidly reduces it to MnP compound II. In contrast, only Mn(II) or ferrocyanide, added at a concentration of 1 equiv, reduces compound II. The Mn(III) produced by the enzymic oxidation of Mn(II) oxidizes the terminal phenolic substrates. This indicates that compounds I and II of MnP contain 2 and 1 oxidizing equiv, respectively, over the native ferric resting enzyme and that the catalytic cycle of the enzyme follows the path native enzyme → compound I → compound II → native enzyme. In addition, these results indicate that Mn(II) serves as an obligatory substrate for MnP compound II, allowing the enzyme to complete its catalytic cycle. Finally, the Mn(II)/Mn(III) redox couple enables the enzyme to rapidly oxidize the terminal phenolic substrates.

52268 **Relationship of tightly bound ADP and ATP to control and catalysis by chloroplast ATP synthase.** Zhou, J.; Xue, Z.; Du, Z.; Melese, T.; Boyer, P.D. (Univ. of California, Los Angeles (USA)). *Biochemistry;* 27: No. 14, 5129-5135(12 Jul 1988). Contract AS03-76ER70102.

Whether the tightly bound ADP that can cause a pronounced inhibition of ATP hydrolysis by the chloroplast ATP synthase and F_1 ATPase (CF_1) is bound at catalytic sites or at noncatalytic regulatory sites or both has been uncertain. The authors have used photolabeling by 2-azido-ATP and 2-azido-ADP to ascertain the location, with Mg^{2+} activation, of tightly bound ADP (a) that inhibits the hydrolysis of ATP by chloroplast ATP synthase, (b) that can result in an inhibited form of CF_1 that slowly regains activity during ATP hydrolysis, and (c) that arises when low concentrations of ADP markedly inhibit the hydrolysis of GTP by CF_1. The data show that in all instances the inhibition is associated with ADP binding without inorganic phosphate (P/sub i/) at catalytic sites. After photophosphorylation of ADP or 2-azido-ADP with [^{32}P]P/sub i/, similar amounts of the corresponding triphosphates are present on washed thylakoid membranes. Trials with appropriately labeled substrates show that a small portion of the tightly bound 2-azido-ATP gives rise to covalent labeling with an ATP moiety at noncatalytic sites but that most of the bound 2-azido-ATP gives rise to covalent labeling with an ATP moiety at noncatalytic sites but that most of the bound 2-azido-ATP gives rise to covalent labeling by an ADP moiety at a catalytic site. They also report the occurrence of a 1-2-min delay in the onset of the Mg^{2+}-induced inhibition after addition of CF_1 to solutions containing Mg^{2+} and ATP, and that this delay is not associated with the filling of noncatalytic sites. A rapid burst of P/sub i/ formation is followed by a much lower, constant steady-state rate. The burst is not observed with GTP as a substrate or with Ca^{2+} as the activating cation.

52269 **Cellular spacings - I. Steady-state growth.** Eshelman, M.A.; Seetharaman, V.; Trivedi, R. (Ames Lab. - USDOE and the Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA (US)). *Acta Metallurgica;* 36: No. 4, 1165-1174(Apr 1988).

Directional solidification studies were carried out in the succinonitrile-acetone and pivalic acid-ethanol systems in order to study the variation in average cellular spacing with velocity. Three distinct behaviors were observed under steady-state growth conditions. For velocities near the critical velocity for planar interface instability, cellular spacing decreased with an increase in velocity. However, at velocities near the cell-dendrite transition the cell spacing increased sharply. Beyond this transition region, the cell or dendrite spacing decreased with further increases in velocity. These experimental observations have been explained by using the current theoretical models of cell-dendrite growth. In addition, a finite band of velocities was identified in which both cellular and dendritic structures were found to be stable. A hysteresis effect was observed in the cell-dendrite transition indicating that the cell-dendrite bifurcation is subcritical.

52270 **Cellular spacings - II. Dynamical studies.** Seetharaman, V.; Eshelman, M.A.; Trivedi, R. (Ames Lab. - USDOE and the Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA (US)). *Acta Metallurgica;* 36: No. 4, 1175-1185(Apr 1988).

Directional solidification experiments were carried out in model transparent systems to establish the dynamical processes by which an unstable planar interface restabilizes into a periodic array of cells. In the succinonitrile-acetone system, where the interface properties are nearly isotropic, the cells increase their spacings by the cell elimination process and decrease their spacings by the tip-splitting mechanism. In the pivalic acid-ethanol system, the significantly anisotropic interface properties do not allow the tip-splitting phenomenon to occur readily. Dynamical studies of the variation in cellular spacing with change in growth rate show that the spacing does not alter until a significantly large change in growth rate is imposed. When a decrease in spacing occurs, two different configurations are observed depending on whether the perturbation which leads to the change is localized or nonlocalized. In the case of a localized perturbation, a propagating tip-splitting mode is observed. For nonlocalized perturbations, the entire interface undergoes a cell-planar-cell transition.

52271 **Pseudo-cooperativity resulting from ring closure in divalent antibody - divalent antigen interactions.** Gandolfi, A.; Strom, R. (Istituto di Analisi dei Sistemi ed Informatica del CNR, Roma (Italy)). pp 119-134 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

In a previous work, they have considered the reaction in solution between a divalent ligand and a divalent receptor, giving a mathematical description of the equilibrium state in terms of concentrations of free sites, and they have analyzed in detail the resulting binding curves in the Scatchard representation. In the present paper they reconsider those results, showing that the occurrence of cyclic complexes can lead to considerable alterations in the epitope binding curves, the extent of these alterations and also their qualitative behavior being strongly dependent on the possible existence of monogamous rings (i.e., of complexes in which both combining sites of a same antibody are bound to the epitopes of a same antigen molecule). When formation of monogamous rings is hindered, the binding curves can achieve shapes which mimic, but are not strictly identical to, those originating from a true positive cooperativity. The authors approach can also be extended to the study of a ternary system in which two different divalent antigens interact with hybrid antibodies. They will show how the binding of one antigen can be enhanced by the presence of the other one, since such a presence allows the formation of circular complexes, thus outlining the rationale for the design of an enzyme immunoassay.

52272 **Idiotypic control of the immune response to ferredoxin.** North, J.; Chu, N.R.; Chan, A.; Steele, J.K.; Singhai, R.; Strammers, A.T.; Levy, J.G. (Univ. of British Columbia, Vancouver (Canada)). pp 163-178 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

In a general study of idiotypic dominance using B-cell hybridomas secreting antibodies specific for the Fd molecule, they somewhat inadvertently found a monoclonal antibody which bore an idiotype apparently expressed in a dominant manner on Fd-specific regulatory T cells. Further experimentation showed that these id^+ T cells and their id^- T cell counterparts controlled the non-responder status of H-2/sup d/ mice to Fd. Adoptive transfer experiments established connectivity between the id^+ and id^- T cell populations in this system. In an attempt to clearly define the interactive T cell populations in this system, they undertook to raise T cell hybridomas, reactive with Fd and capable of down regulating the anti-Fd response. The Fd11 T cell hybridoma has demonstrated the required characteristics. The soluble material secreted by this hybridoma was shown to bind specifically to Fd as well as to an anti-TsF monoclonal B16G. Further, Fd11 TsF was shown to down regulate the secondary antibody response to Fd by B10.D2 mice when administered concurrently with the secondary antigenic stimulus. The possibility that the Fd11 TsF was acting via idiotypic interactions was supported by the observations that if Fd11 material was injected into Fd non-responder animals 10 days prior to antigenic stimulus, the animals were converted to the responder status.

52273 **Role of $I\text{-}J^+$ macrophages in the induction of antigen B-specific T-suppressor cells.** Malley, A.; Shiigi, S.M. (Oregon Regional Primate Research Center, Beaverton (USA)). pp 187-206 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

In this report, they shall show that successful induction of AgB-specific T/sub s/ cells requires as few as 10^3 histocompatible and $I\text{-}J^+$ bone-marrow-derived macrophages (BMDM). Flow cytometric analysis of BMDM with a polyclonal anti-I-J/sup k/ (3R anti-5R IgM antibody), monoclonal anti-I-A/sup k/, and a monoclonal anti-I-J/sup k/ (clone JK10-23) not only confirmed the presence of I-J antigens on the surface of BMDM, but also demonstrated that the appearance of I-J on the cell surface began after the bone marrow cultures were devoid of contaminating cells and paralleled the development of macrophages. In addition, NP-40 extracts of BMDM immunoprecipitated with either monoclonal anti-I-A/sup k/ or anti-I-J/sup k/ antibodies, and analyzed by SDS-PAGE and Western Blots indicated that the anti-I-A/sup k/ antibody showed reactivity with a 30 and 33 Kd protein bands while the anti-I-J/sup k/ antibody showed reactivity only with a 30Kd protein band.

5503 Cytology

52274 (INIS-mf—11309, pp 135) **Device for measuring the contractile force of muscular samples designed for NMR study.** Schanck, A.; Baguet, F. (Louvain Univ. (Belgium)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

5504 Genetics

REFER ALSO TO CITATION(S) 50956, 52335

52275 **(DOE/ER/10888—3) [Genetic engineering with a gene encoding a soybean storage protein to identify DNA sequences that control its expression]: [Final] Progress report, April 1, 1985--March 31, 1988.** Beachy, R.N. (Washington Univ., St. Louis, MO (USA). Dept. of Biology). 1988. Contract AC02-81ER10888. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016548/JAW.

The goals of the research were to isolate and characterize genomic clones encoding subunits of β-conglycinin, a soybean seed storage protein. Subsequent to gene isolation the expression of these genes was to be studied via expression in transgenic plants, and the sequences that affect the expression of these genes in transgenic plants was to be identified. An additional goal of the work was to study the chromatin structure of one or more the β-conglycinin genes. Originally, a single gene (the α'-subunit gene) was to be studied. In the course of the work, however, we were fortunate to screen a genomic library to find a second member of the gene family, the β-subunit gene. The identification of this gene adds tremendously to the breadth of the project because, as described previously, its program of gene expression is different than that of the α'-subunit gene. By using both the α' and β genes we are able to study not only tissue specificity of gene expression, but the differences in temporal regulation of the expression of two members of the gene family. Research is described. 8 refs.

52276 **(DOE/ER/13377—3) Genomic variation in maize: Annual and summary report, 1988.** Rivin, C.J. (Oregon State Univ., Corvallis (USA). Dept. of Botany and Plant Pathology). 1988. Contract FG06-85ER13377. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015520/JAW.

We are interested in the molecular basis and biological significance of genomic diversity. Our laboratory has been studying genomic variation in maize and examples of rapidly occurring changes in maize DNA. To understand the mechanisms that generate and maintain variation, the author's lab has followed the reproducibility and stability of new repeated sequence multiplicities in succeeding generations, during plant development and in regenerated plants. We have also initiated studies of the Robertson's Mutator transposon system. These transposons have been shown to be quite variable in copy number in Mutator stocks of maize, but were reported to be absent in normal maize lines. We showed that sequences homologous to the transposon exist in a variety of forms in normal maize, including complete transposon structures. Results are discussed. 3 figs., 1 tab.

5505 Metabolism

REFER ALSO TO CITATION(S) 50908, 52077, 52153, 52418, 52419, 52434

52277 (BNL—39428, pp P33) **Influence of physical activity on the metabolism and the total body content of sodium and potassium in the rat.** Yeh, J.K.; Yasumura, A.; Aloia, J.F. (Winthrop-Univ. Hospital, Mineola, NY (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The purpose of this study was to investigate the effect of exercise (EX) and immobilization (IMB) on the absorption, excretion and total body content of sodium (TBNa) and potassium (TBK). Female Sprague Dawley rats 5 weeks old were divided into four groups: EX; Control (CON); EX with pair feeding to the level equal to the CON (EX-P); IMB by sciatica denervation. The nutritional balance study data was taken 5 weeks into the experimental period and the animals were sacrificed after 5 additional weeks of experimentation. The carcasses were kept frozen and used for total body composition by neutron activation. The results of the total body composition show that EX resulted in an increase, IMB resulted in a decrease, of the TBNa and TBK. There was no significant difference in TBNa of TBK, between the EX and the EX-P

groups even though, the food intake was higher in the EX group. The results of the nutritional balance study confirmed the results of the total body composition.

5506 Medicine

REFER ALSO TO CITATION(S) 50600, 50876, 50879, 51234, 51728, 52391, 52415, 52418, 52424, 52714, 52715, 52716, 52744, 52748

52278 (BNL—39428, pp B2) **Non-invasive techniques for quantitating bone mass - fact or fancy.** Chesnut, C.H. III. (Univ. of Washington School of Medicine, Seattle (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

As bone mass is the principle determinant of fracture, a non-invasive quantitation of bone mass would theoretically be of value in bone-wasting disease in (a) predicting the risk of fracture, (b) quantitating the severity of disease, and (c) following response to therapy. The past 20 years have seen the development of a number of non-invasive procedures, including radiogrammetry (RG) and radiographic photo densitometry (RD), single and dual photon absorptiometry (SPA) and (DPA), computed tomography (CT), and total body calcium neutron activation analysis (TBC); such techniques are capable of quantitating bone mass at those axial, appendicular, and total skeletal sites encompassing the principle areas involved in bone-wasting diseases. In addition, these measured sites exhibit varying proportions of cortical and trabecular bone; trabecular bone appears to be metabolically more active than cortical bone, to be preferentially altered in osteoporosis and other metabolic bone diseases, and to be the type of bone most affected by the majority of medications utilized in the treatment of most metabolic bone disease.

52279 (BNL—39428, pp B3) **Osteoporosis in patients with inflammatory bowel disease.** Compston, J.E.; Evans, W.D.; Crawley, E.O.; Judd, D.; Evans, C.; Rhodes, J. (Univ. of Wales College of Medicine, Cardiff (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The prevalence of osteoporosis in inflammatory bowel disease (IBD) has not been accurately established. Using single photon absorptiometry (SPA) and vertebral quantitative computerized tomography (QCT) the authors measured bone mineral content (BMC) in 75 unselected patients with IBD. Osteoporosis was present in 23 (31%). Seven had cortical and trabecular osteoporosis, 11 cortical only and five trabecular only. Three amenorrhoeic premenopausal females had clinically severe osteoporosis and a further 4 had vertebral crush fractures. The median lifetime steroid dose in osteoporotic patients was significantly greater than in patients with normal BMC; most patients with osteoporosis had small bowel IBD with one or more resections. Repeat QCT measurements in 18 patients after one year were unchanged in 12, increased in one and decreased between 10 and 37 mg/ml K_2HPO_4 in 5 of whom four were receiving steroids. Radial BMC decreased in one patient, increased in one and was unchanged in the remainder. Thus, osteoporosis was present in 30% of these patients, with severe clinical disease in three young females. Rapid spinal trabecular bone loss was demonstrated over the course of one year in some patients. Steroid therapy, amenorrhoe and small bowel IBD with resection appear to be important risk factors.

52280 (BNL—39428, pp B4) **Bone loss in rheumatoid arthritis.** Gotfredsen, A.; Als, O.S.; Hassager, C.; Christiansen, C. (Univ. of Copenhagen, Glostrup (Denmark)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The authors studied 159 patients with rheumatoid arthritis (RA) treated with a variety of drugs. Stratification of the patients was done according to treatment, sex, menopausal state, duration of the disease, and functional impairment. Forearm bone mineral content (BMC) and total body bone mineral (TBBM) were measured by single and dual photon absorptiometry. Bone turnover was estimated by biochemical markers. All patients had significantly decreased BMC and TBBM compared to normals. Comparing glucocorticoid and penicillamine treatment in premenopausal patients, they found significantly lower BMC and TBBM values in the glucocorticoid treated group. However, no differences in BMC and TBBM values were found in the corresponding postmenopausal groups. In the premenopausal glucocorticoid group with the duration of treatment and cumulated dose correlated with BMC, whereas no such correlations were found in the postmenopausal women. In the patients who did not receive glucocorticoids they found significant relationships between BMC and functional impairment as well as duration of the disease. Indices of bone turnover rose with increasing functional, impairment, particularly those of bone resorption.

52281 (BNL—39428, pp B6) **Bone changes occurring spontaneously and caused by estrogen in early postmenopausal women: a local generalized phenomenon?.** Christiansen, C.; Gotfredsen, A.; Riis, B.J.; Hassager, C. (Univ. of Copenhagen, Glostrup (Denmark)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Regional values of bone mineral content and bone mineral density were calculated from total body dual photon absorptiometry scans of 52 early postmenopausal women treated with estrogen for one year and of 52 similar women treated with placebo. The six regions were head, arms, chest, spine, pelvis, and legs. In addition, bone mineral density of the spine was calculated by dual photon absorptiometry and bone mineral content of the forearm by single photon absorptiometry, using separate special purpose scanners. All regions were unchanged after one year of treatment with estrogen, excluding the lumbar spine, for which values rose. Values for all regions except the lumbar spine fell significantly in the placebo group. The rates of loss ranged from 2 to 8%, with no significant differences between the regions. It is concluded that loss of bone in the early menopause is a generalized phenomenon, affecting all parts of the skeleton. Furthermore, estrogen prophylaxis for loss of bone is effective in all parts of the skeleton. Finally, it is suggested that the measurement of bone mineral content in the forearm be used for clinical follow up of bone changes, as this method is superior to others in the ratio of change to precision.

52282 (BNL—39428, pp B7) **Evaluation of central skeleton, neutron activation analysis for the routine diagnosis of osteopenia.** Harrison, J.E.; McNeill, K.G.; Patt, N.; Mueller, C.; Chow, R. (Univ. of Toronto (Canada)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

At Toronto, NAA is used to quantitate the total bone mineral in the central third of the skeleton and results are expressed as fractions of the mean values for normal young adults (<55 yrs) of the same body size, based on height and arm span. The normal range for this Calcium Bone Index, CaBI, is 0.75-1.20. The CaBI values for 181 patients, investigated for postmenopausal osteoporosis, were compared to spinal x-ray measurements of vertebral deformity. Fractures were defined as vertebral compression > 10% or wedging with anterior/posterior vertebral heights (A/P ratio) < 0.67 for thoracic and < 0.75 for lumbar vertebrae. The 127 patients without fractures had a mean CaBI = 0.81 +/- 0.13 with low CaBI values (< 0.75) in 24% of cases. The 54 patients with fractures had a mean CaBI = 0.67 +/- 0.12 with CaBI < 0.75 in 80%. Thus, the authors CaBI gives useful separation between these two groups. Furthermore, 10 of the 11 fracture patients with normal CaBI values had only one thoracic fracture and this isolated deformity may not necessarily reflect significant osteopenia: 97% of patients with multiple fractures had CaBI < 0.75. Results by dual photon absorptiometry (DPA) correlate significant (r = 0.73) to CaBI values but with a large s Σ Σ (+/- 13.5%) so that the value by one procedure may not predict reliably that of the other.

52283 (BNL—39428, pp B8) **Bone mineral measurements and the pathogenesis of osteoporosis.** Aloia, J.F.; Vaswani, A.N.; Ellis, K.J.; Cohn, S.H. (Winthrop-Univ. Hospital, Mineola, NY (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Low bone mass (osteopenia) is a major factor in the development of osteoporotic fractures in women after the menopause. The pathogenesis of postmenopausal osteoporosis has been pursued by dual lines of investigation: (1) development of a model to describe involutional bone loss, (2) identification of those factors which result in some healthy women having a greater risk for osteoporosis than others. Bone mineral measurements have been made using in vivo neutron activation analysis and whole body counting for the measurement of total body calcium (TBCa), single photon absorptiometry for the measurement of bone mineral content of the distal radius and dual photon absorptiometry for measurement of the bone density of the spine. TBCa is higher in men than women and is lost at a slow linear rate in men. Blacks have a skeletal mass about 8-9% higher than Caucasians. Women have a similar loss of TBCa to men prior to menopause, but then have an accelerated rate of loss after menopause. The change in bone density of the radius and spine with increasing age is also best described by a 2 phase regression in women, with appreciable loss after age 50.

52284 (BNL—39428, pp B9) **Sequential and population bone mineral measurement (BMM) using dual energy (spine) and single energy (femur and forearm) photon absorptiometry.** Aird, E.G.A. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The methods of BMM available in Newcastle will be described briefly. These are: (1) a commercial machine (NOVO) for dual energy, area scanning of the spine; (2) a machine built in Newcastle using fluorescent X-rays, primarily intended for measurement of the femur; (3) a commercial machine (NOVO) for single energy measurement of the forearm. The long term reproducibility for patient measurements will be discussed for all three methods including the impact of new software for the spine machine. The results of population studies of various groups of renal patients and osteoporotic patients will be presented. The results of sequential measurements at all three sites on a group of ostoeporotic patients, in which some have been treated with calcitonin, will be discussed. Initial studies on BMM of patients treated for primary biliary cirrhosis will be presented.

52285 (BNL—39428, pp B10) **Ultrasonic studies of the os-calcis in vivo.** Palmer, S.B.; Langton, C.M. (Univ. of Hull (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

It has now been more than two years since the initial report of the relevance of the measurement of the frequency dependence of ultrasonic attenuation of the os-calcis to the trabecular structure of the bone. Since that time the authors have been engaged in further studies in two directions. Firstly, they are examining the underlying physical mechanisms associated with the interaction of the ultrasound with the cancellous bone of the os-calcis. Secondly, they have been conducting a series of clinical trials in collaboration with medical centers in the UK. These trials have allowed them to assess the relevance of ultrasonic bone analysis (UBA) to a range of medical conditions, including osteoporosis, and to compare UBA to techniques used at present such as single and dual photon absorption, C.T. scanning and morphology. This work has been carried out in parallel with developments of the technique itself which have allowed improvements in the speed and reproducibility of the measurement. The presentation will review the progress made to date in these various directions and consider the possible future developments.

52286 (BNL—39428, pp C3) **Study of the sites of body fat loss by NMR imaging.** Fuller, M.F.; Stratton, S.M.; Fowler, P.A.; Foster, M.A. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

This study was undertaken to assess how well NMR imaging can be used to detect the modest differential losses of fat from various parts of the body that may be of significance during a period of sustained weight loss. A group of 18 women volunteers, were studied before, during and after over a period in which they were losing weight by following a diet giving them an average intake of 1400 Kcal/d. The regional pattern of adipose tissue loss was examined by making images in each of six transaxial planes, two on the thorax, two on the abdomen and two on the thighs. The instrument used was the Aberdeen MkII imager operating at 3.4 MHz using pulse sequences based on the Aberdeen spin-warp imaging technique.

52287 (BNL—39428, pp D7) **In vivo F-19 magnetic resonance spectroscopy in humans.** Silver, M.S.; Wolf, W.; Sauer, R.; Albright, M. (Siemens Medical Systems, Inc., Iselin, NJ (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The authors have obtained for the first time in vivo F-19 spectra of the chemotherapeutic agent 5-Fluorouracil (5FU) and at least one of its catabolites, αFluoro-β alanine (FBAL), from the intact liver of several patients undergoing chemotherapy. These results demonstrate the feasibility of in vivo F-19 spectroscopy in studying drug metabolism. Previous F-19 studies of 5FU have been carried out in vitro or in vivo in animals, and in F-18 studies on patients. Spectra were obtained using a 1.5 Tesla Magnetom, operating with a resonant frequency of 59.8 MHz. Spectra were collected and signal averaged over an eight minute period, commencing with the administration of the chemotherapy. This was done while the patient was within the magnet. A control spectrum before drug administration was taken to preclude the presence of an residual levels of 5FU. A surface coil 15 cm in diameter was used as a transmitting/receiving coil, and a $\approx 90^{\circ}$ pulse was optimized for $\approx$ 5 cm above the surface of the coil. The patients were positioned face down on the imaging table so that the liver was located directly above the surface coil.

52288 (BNL—39428, pp P18) **In vitro comparison of DE-QCT parameters with the compressive strength of cancellous bone.** Oravez, W.T.; Robertson, D.D. (Siemens Medical Systems, Inc., Iselin, NJ (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Quantitative computed tomography (QCT) is used as a method for assessing bone mineral in patients with osteoporosis. The implication being that if the mass of bone mineral is low enough then the patient is at risk for developing symptoms, i.e., fracture. The authors performed an in vitro test which compared dual-energy-QCT (DE-QCT) parameters with compressive strength. The bone samples were placed in a water bath and CT scanned using a Siemens DR-3. Alternating x-ray pulses of 125 and 85 kVp were used to generate the dual energy images. Four images, high kVp, low kVp, monoenergenic, and calcium equivalent, were reconstructed from each scan. A specially constructed bone mineral calibration phantom, consisting of a polyethylene rod and varying tubes of K2HP04, was placed within the water bath along with the specimens. Comparisons will be made between the various DE parameters and their relationship to the compressive strength of cancellous bone. The critical effect of trabecular bone orientation will also be discussed.

52289 (CONF-760202—, pp 781-786) **Instant display in the operating room.** Sashin, D.; Ricci, J.L.; Morris, C.W. (Univ. of Pittsburgh, PA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

An inexpensive, commercially available single storage magnetic disc recorder has been modified for use in the operating room where fluoroscopy had been previously required. Preliminary evaluation was begun to determine the clinical usefulness of the new system and its effect on the procedure time and radiation exposure to the patient and personnel. Images of excellent quality have been obtained during hip fixation, needle biopsy, transsphenoidal hypophysectomy, pacemaker insertion and umbrella catheter placement in the vena cava. Initial comments form all the surgeons using the disc recorder have been highly favorable. A further application of the system is that at low cost, selected stored images of excellent quality can be easily photographed and then included in the patient's chart or for use in conferences.

52290 **(DOE/ER/60210—4) Development and evaluation of an improved high-resolution TOFPET camera: TOFPET II: Progress report for fiscal year 1987.** Mullani, N.A. (Texas Univ., Houston (USA). Health Science Center). Jun 1988. Contract FG05-84ER60210. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014730/JAW.

A detailed description of TOFPET II is included in subsequent sections. A majority of the components for this new camera are completed and tested. Final assembly of the system and modification of the components to commercial standards will be carried out by Positron Corporation under a contract with Clayton Foundation for Research. Testing and software development for TOF studies will be carried out by The University of Texas group. A brief description of the status of TOFPET II is given.

52291 **(DOE/ER/60634—T1) Theory of RBE: Annual technical progress report, 1 January 1988–31 December 1988.** Katz, R. (Nebraska Univ., Lincoln (USA). Dept. of Physics). 15 Jul 1988. Contract FG02-88ER60634. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014238/JAW.

Attention during this period has focused on the following: improvement in knowledge of the radial distribution of dose about the path of an energetic heavy ion in different media; application of the new radial dose algorithm to the data of Montret for the heavy ion response of LiF; the concept of a minimal radius for etched tracks; parameterization of data for chromosome damage in Chinese hamster cells; the discovery of 1 hit and 2 hit detectors in radiation chemistry.

52292 (INIS-mf—11309, pp 128-129) **Determination of the regional response to renal hypotension using a spectroscopic imaging technique.** Freeman, D.M.; Hurd, R.; Barker, P.B.; Jones, L.; Benninghoven, S.; Moress, E.; Ward, L.; Ross, B.D. (GE NMR Instruments, Fremont (USA); HMRI, Pasadena (USA)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52293 (INIS-mf—11309, pp 127) **Streptococcus faecalis: a model for studying the mode of action of carboxylic polyether ionophorous antibiotics by 'in vivo' NMR.** Delfort, A.M.; Dauphin, G.; Guyot, J.; Jeminet, G. (Universite Blaise Pascal, Laboratoire de Chimie Organique Biologique, Aubiere (France)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52294 (INIS-mf—11309, pp 126) **/sup 1/H COSY spectra of superfused brain slices of rat: ex vivo direct assignment of resonances.** Gillet, B.; Mergui, S.; Beloeil, J.C.; Champagnat, J.; Fortin, G. (Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France). Inst. de Chimie des Substances Naturelles; Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52295 (INIS-mf—11309, pp 119-120) **Tissue characterization by parameter extraction from nuclear relaxation dispersion curves.** Rinck, P.A.; Lowenthal, A.; Karcher, D.; Elst, L. vander; Haverbeke, Y. van; Muller, R.N.; Fischer, H.W. (Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway); Universitaire Instelling Antwerpen (Belgium); Mons Univ. (Belgium)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52296 **(INIS-mf—11777) 23rd annual meeting of German Society for Neuroradiology. Abstracts.** Kuehne, D. (ed.). (Deutsche Gesellschaft fuer Neuroradiologie e.V., Hamburg (Germany, F.R.)). 1987. 58p. (In German). (CONF-8710357—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754333/JAW.

From 23. annual meeting of the Deutsche Gesellschaft fuer Neuroradiologie e.V.; Essen, F.R. Germany (15 Oct 1987).

Book of abstracts of this annual meeting summarizing the 58 lectures that dealt with the following subjects: Pathologic changes of the cervical vertebral canal and of the cervico-occipital region, as detected by modern imaging techniques (18 papers); diagnostic examination of the urbita and the middle cranial fossa (12 papers); invasive methods of neuroradiology (13 papers); 15 papers on freely chosen subjects.

52297 **(INIS-mf—11780) Bone density determination using I/sup 125/ densitometry with idiopathic scoliosis.** Weinberger, N. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 10 Jul 1984. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754835/JAW.

Based on the assumption that radiographs from patients with idiopathic scoliosis show osteoporotic changes in the curved area, investigation with I/sup 125/-densitometry were made, and specifically with measurement points at the ulna and the calcaneus. A difference in the bone density between patients with scoliosis and normal controls could not be proven. The mineral-salt content of the scoliosis patients lay on the average 6.5 to 9.3% lower than the normal controls. No relation could be found between the degree of curvature of the scoliosis and the peripheral bone density, from which it can be concluded that no generalized mineral-salt deficiency exists. Radiographs show only local changes (photo densitometry, computed tomography). (TRV).

52298 **(INIS-mf—11787) Development and construction of resistive NMR-tomographs and their application in medical diagnosis and research.** Post, H.; Knuettel, B. (Bruker Analytische Messtechnik G.m.b.H., Rheinstetten (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Feb 1985. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754836/JAW.

The development of NMR-tomography for examinations of the human body started with the construction of a test version to be used in a laboratory only, and has further advanced to a prototype for clinical routine use. The following two systems have been tested: a) A resistive air coil system with a proton resonance frequency of 6 MHz was developed to a prototype and installed at the Deutsche Klinik fuer Diagnostik in Wiesbaden. b) An air core system with integrated iron shielding with a proton resonance fre-

quency of 12 MHz was developed and put into operation. These two systems demonstrate the possibility of achieving excellent results in clinical diagnosis by using low priced resistive magnets in NMR-tomography. (orig.) With 25 figs.

52299 **(INIS-mf—11789) Comparative study for small computer supported clearance determination with /sup 131/ iodine hippuran using CdTe detectors.** Duerr, G. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 1986. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754837/JAW.

With the goal to work out a simple, non-invasive method for the total clearance determination also for immobile patients, we carried out this clearance study with CdTe semi-conductor detectors. The /sup 131/iodine hippuran clearance determination was carried out on 69 patients in the nuclear medicine department of the Radiological Policlinic in the framework of a routine diagnosis with ambulant and stationary patients with a gamma camera and a connecting evaluation system. At the same time we recorded the shoulder curves using two CdTe semi-conductor detectors and deposited the data in a portable semi-conductor memory. Next the hypotheses for the routine use with the inclusion of commercially common small computers was worked out. The plasma disappearance curves which were recorded over the shoulder region were evaluated with a small computer according to the method of the modified Oberhausen tables and the Oberhausen formula.

52300 **(INIS-mf—11806) For the development of therapy with ionising radiation in tooth, mouth and jaw medicine. An historical summary.** Halbleib, T. (Giessen Univ. (Germany, F.R.). Fachbereich Humanmedizin). 1983. 191p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754840/JAW.

Based on the corresponding literature study, the development of therapy with ionising radiation, especially in the areas of tooth, mouth and jaw medicine, is reported from the discovery of X-rays up till the present. First from 1915 on did the X-ray antiphlogistic irradiation with in importance, from 1925 to about 1940 it played a domineering role, after the war was hardly still in use and since 1970 is considered in the stomatological sector obsolete. In comparison, already in 1905 there were individual successes in tumor therapy using X radiation. After many failures and competition with the method of radium therapy in the following years, a new upswing in X-radiation came starting in around 1930 with the introduction of the Chaoul contact therapy. The high point of this development is the introduction of supervolt therapy starting around 1965. It is the result of comprehensive research in the area of radiation physics. As a result of further developed techniques there were soon combined and competing procedures available, whose results, however, have not been adequately compared and documented. From 1970 on electronic data processing has primarily taken over individual irradiation planning (cobalt 60 and electron irradiation), predictions about clinically relevant therapy successes are not present at this time. (TRV).

52301 (NEI-NO—52, pp 7) **Strategy for biomedical radiography of apical periodontium.** Halse, A.; Molven, O. (Bergen Univ. (Norway)). 1986. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52302 (NEI-NO—52, pp 9) **Radiographic reproduction of the endodontic "working length" comparing the paralleling and the bisecting-angle technique.** Forsberg, J. (Bergen Univ. (Norway)). 1986. (In Danish, English, Norwegian, Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52303 (NEI-NO—52, pp 10) **Radiographic classification of healing after endodontic surgery.** Molven, O.; Halse, A.; Grung, B. (Bergen Univ. (Norway); Rogaland Central Hospital, Stavanger (NO)). 1986. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52304 (NEI-NO—52, pp 14) **Comparison of bite wings with panoramic radiographs for detection of approximal caries.** Syrjaenen, S.; White, S.; Gaestrin, J. (Kuopio University (FI); California Univ., Berkeley (USA); Palomex instrumentarium, Helsinki (FI)). 1986. (In Danish, English, Norwegian, Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52305 (NEI-NO—52, pp 15) **Direct sagittal computerized tomography of jaw joints.** Haakansson, H. (Kristianstad Central Hospital (SE)). 1986. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52306 (NEI-NO—52, pp 17) **Panoramic radiography of the temporomandibular joint by zonegraphy in posterior-anterior projection.** Syrjaenen, S.; Pohjola, E.; Maekelae, A.M.; Soimakallio, S. (Kuopio University (FI); Kuopio Central Hospital (Finland)). 1986. (In Danish, English, Norwegian, Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52307 (NEI-NO—52, pp 18) **Impaired mandibular function and possible effect on mandibular growth in juvenile rheumatoid arthritis.** Stabrun, A.E.; Larheim, T.A.; Roesler, M.; Haanaes, M.; Hoeyeraal, H.M. (Oslo Univ. (Norway)). 1986. (In Danish, English, Norwegian, Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52308 (NEI-NO—52, pp 23) **Energy imparted to the Swedish population from intraoral radiography.** Stenstroem, B.; Henrikson, C.O.; Bergman, K.; Blomgren, P.G. (National Inst. of Radiation Protection, Stockholm (Sweden)). 1986. (In Danish, English, Norwegian, Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52309 **(NEI-NO—52) Nordic symposium on biomedical radiography in odontology. NSOR 11th meeting.** (Bergen Univ. (Norway)). 1986. 34p. (In Danish, English, Norwegian, Swedish). (CONF-8605348—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW.

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

The booklet presents pre-conference abstracts of 27 lectures given at the meeting. Abstracts of nine of the papers are put forward as separate input.

52310 **(PB—88-866900/XAB) Nuclear magnetic resonance: applications in medical diagnosis. January 1978-July 1988 (Citations from the Life Sciences Collection data base). Report for January 1978-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 43p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the application of nuclear magnetic resonance imaging (NMR) to medical diagnostics. NMR studies of biological systems, organ failure, drug interactions, and biological fluids are discussed. Membrane alteration, neurological disorders, cancer, antigen identification, and blood-cell monitoring using nuclear magnetic resonance diagnostic techniques are also examined. (Contains 82 citations fully indexed and including a title list.)

52311 **(PB—88-866926/XAB) Nuclear magnetic resonance as a diagnostic tool. January 1970-July 1988 (Citations from the NTIS data base). Report for January 1970-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 64p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the use of nuclear magnetic resonance imaging (NMR) in medicine. Biological effects of magnetic fields, equipment used in NMR medical diagnostics, processing and display of NMR data, guidelines and safety aspects of medical NMR imaging, and planning for the need for NMR imaging services are among the topics examined. The study of specific diseases using nuclear magnetic resonance technology, while briefly included, is discussed in depth in a separate bibliography. (Contains 100 citations fully indexed and including a title list.)

52312 **Effect of zinc ions on tRNA structure: imino proton NMR spectroscopy.** Flanagan, J.M.; Jacobson, K.B. (Oak Ridge National Lab., TN (USA)). *Biochemistry;* **27**: No. 15, 5778-5785(26 Jul 1988). Contract AC05-84OR21400.

The structure of tRNA in solution was explored by NMR spectroscopy to evaluate the effect of divalent cations, especially zinc, which has a profound effect on the chromatographic behavior of tRNAs in certain systems. The divalent ions Mg^{2+} and Zn^{2+} have specific effects on the imino proton region of the ^1H NMR spectrum of valine transfer RNA (tRNA/sup Val/) of Escherichia coli and of phenylalanine transfer RNA (tRNA/sup Phe/) of yeast. The dependence of the imino proton spectra of the two tRNAs was examined as a function of Zn^{2+} concentration. In both tRNAs the tertiary base pair (G-15) x (C-48) was markedly affected by Zn^{2+} (shifted downfield possibly by as much as 0.4 ppm); this is the terminal base pair in the augmented dihydrouridine helix (D-helix). Base pair (U-8) x (A-14) in yeast tRNA/sup Phe/ or (s^4U-8) x (A-14) in $tRNA_1$/sup Val/, which are stacked on (G-15) x (C-48), was not affected by Zn^{2+}, except when 1-2 Mg^{2+} ions per tRNA were also present. Another imino proton that may be affected by Zn^{2+} in both tRNAs is that of the tertiary base pair (G-19) x (C-46). The assignment of this resonance in yeast tRNA/sup Phe/ is tentative since it is located in the region of highly overlapping resonances between 12.6 and 12.3 ppm. This base pair helps to anchor the D-loop to the T Psi C loop. Surprisingly, the imino proton of (G-18) x (Psi-55) is not similarly affected by Zn^{2+}, indicating that the effect of Zn^{2+} is not on G-57 which is the central non-hydrogen-bonded base in the guanosine sandwich created by the stacking of G-19, G-57, and G-20. The solution structure of tRNA/sup Phe/ shows marked correlation to the crystal structure in terms of Zn^{2+} interactions.

52313 **Copper sites of dopamine β-hydroxylase: an X-ray absorption spectroscopic study.** Scott, R.A.; Sullivan, R.J.; DeWolf, W.E. Jr.; Dolle, R.E.; Kruse, L.I. (Univ. of Georgia, Athens (USA)). *Biochemistry;* **27**: No. 15, 5411-5417(26 Jul 1988).

X-ray absorption edge and extended X-ray absorption fine structure (EXAFS) spectra are reported for the Cu(I) and Cu(II) forms of bovine dopamine β-hydroxylase and for the Cu(I) form of DBH bound either to tyramine substrate or to a multisubstrate inhibitor. A significant change in the structure of the copper sites occurs upon ascorbate-mediated reduction of Cu(II) DBH to the Cu(I) form. While the average Cu(II) site most likely consists of a square-planar array of four (N,O)-containing ligands at 1.98 A, the average Cu(I) site shows a reduction in (N,O) coordination number (from ~ 4 to ~ 2) and the addition of a S-containing ligand at 2.30 A. No change in the average Cu(I) ligand environment accompanies binding of tyramine substrate, whereas binding of a multisubstrate inhibitor, 1-(3,5-difluoro-4-hydroxybenzyl)-1H-imidazole-2(3H)-thione, causes an increase in the Cu-S coordination, consistent with inhibitor binding to the Cu(I) site through the S atom. Although excellent signal-to-noise ratio in the EXAFS spectra of ascorbate-reduced DBH facilitated analysis of outer-shell scattering for a Cu...Cu interaction, the presence of a binuclear site could not be proven or disproven due to interference from Cu...C scattering involving the carbons of imidazole ligands.

52314 **Comparison of the resonance raman properties of the fast and slow forms of cytochrome oxidase.** Schoonover, J.R.; Dyer, R.B.; Woodruff, W.H.; Baker, G.M.; Noguchi, M.; Palmer, G. (Los Alamos National Lab., NM (USA)). *Biochemistry;* **27**: No. 15, 5433-5440(26 Jul 1988).

Resonance Raman (RR) spectra of the rapid and slow forms of resting cytochrome oxidase obtained with Soret excitation at 413.1 nm are reported. There are a number of conspicuous differences between the two forms in the high-frequency region of the RR spectrum which involve changes in Raman intensity arising from a blue shift in the Soret maximum of cytochrome a_3 upon conversion to the slow form. In the low-frequency region a peak present at 223 cm^{-1} in the rapid form shifts to 220 cm^{-1} in the slow form; this peak is assigned as the cytochrome a_3 Fe(III)-N(His-Im) stretch. The slow form of the enzyme possesses greater intensity in RR peaks near 1620 cm^{-1} which have been previously attributed by others to partial photoreduction of the enzyme. The authors have quantitated the amount of laser-induced photoreduction in these RR spectra by comparison with the spectra of mixed-valence derivatives of the enzyme and find that these 1620-cm^{-1} features are unreliable indicators of photoreduction. The spectra of the fast- and slow-reacting species in H_2O and D_2O have been compared. These deuterium shifts are not observed in the slow form. They suggest that the nature of the difference between the fast and slow forms of the enzyme is a global conformational change involving inter alia the axial histidine ligand of cytochrome a_3 and the cytochrome a environment. This conformational change is also responsible for the enhanced Raman intensity observed at 1620 cm^{-1} in the slow form. Some mechanisms whereby such a conformational change might affect the cytochrome a_3 Soret energy are discussed.

52315 **Expression and stability of c-sis mRNA in human glioblastoma cells.** Press, R.D.; Samols, D.; Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA)). *Biochemistry;* **27**: No. 15, 5736-5741(26 Jul 1988). Contract FG02-87ER60587.

The production of platelet-derived growth factor like (PDGF-like) material by glioblastomas may be involved in the conversion of normal cells to tumor cells. In an investigation of this problem, the authors have examined some of the properties of the platelet-derived growth factor B-chain mRNA (c-sis mRNA) by a sensitive and quantitative RNA-RNA solution hybridization method. In 5 out of 8 human glioblastoma cell lines, c-sis mRNA was present, and in the line with the highest level, there were approximately 4-10 molecules per cell. The half-lives of the c-sis mRNA in two glioblastoma cell lines were 2.6 and 3.4 h, while in human umbilical vein endothelial (HUVE) and bladder carcinoma (T24) cells they were 1.6 and 2.5 h, respectively. Inhibiting protein synthesis produced no significant alteration of the c-sis mRNA half-lives in the glioblastoma or HUVE cells. The A-U-rich sequence at the 3' end of the c-sis mRNA therefore does not appear to affect the mRNA stability in the presence of cycloheximide as it does in other transcripts. The similarity of the c-sis mRNA half-lives in normal and tumor cells suggests that regulation of stability of c-sis mRNA is not a major factor in tumorigenesis in the glioblastoma cell lines examined.

52316 **Options in camera technology for the bone scan: role of SPECT.** Weber, D.A. (Brookhaven National Lab., Upton, NY (USA)). *Seminars in Nuclear Medicine;* **18**: No. 2, 78-89(Apr 1988).

Planar imaging with current generation gamma cameras and tomographic imaging with current generation rotating camera

single photon emission computed tomography (SPECT) systems provide excellent spatial resolution and good fidelity between image quantitation and activity levels. Their use in imaging the localization and clearance of skeletal imaging agents such as the Tc-99m labeled diphosphonates, Ga-67 citrate, and In-111 leukocytes offers a sensitive and accurate means to detect occult disease and to investigate skeletal blood flow, metabolism, and pathology. SPECT progressively plays an increasingly important role in imaging studies of joint disease, infection, avascular necrosis, bone growth, developmental abnormalities and the effects of weight bearing, exercise, and other forms of treatment on skeletal repair processes. 21 references.

5507 Microbiology

REFER ALSO TO CITATION(S) 50499, 50968, 51751, 52153, 52173

52317 **(CONF-8808105—1) Advanced bioreactor concepts for coal processing.** Scott, C.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015563/JAW.

From Processing of coals workshop; Washington, DC, USA (15 Aug 1988).

The development of advanced bioreactor systems for the processing of coal should follow some basic principles. Continuous operation is preferred, with maximum bioreagent concentrations and enhanced mass transfer. Although conventional stirred-tank bioreactors will be more appropriate for some processing concepts, columnar reactors with retained bioreagents could be the system of choice for most of the applications. Serious consideration must now be given to process development of some biological coal processing concepts. Process biology and biochemistry will continue to be very important, but efficient bioreactor systems will be necessary for economic feasibility. Conventional bioreactor concepts will be useful for some applications, but columnar systems represent an innovative approach to the design of continuous bioreactors with high productivity and good operational control. Fluidized and packed beds are the most promising configurations, especially where three-phase operation is required and where interphase mass transport is a likely controlling mechanism. Although the biocatalyst must be immobilized into or onto particles to be retained in the bioreactors, this also results in a very high biocatalyst concentration without washout and a significant enhancement in bioconversion rates. The multistage nature of these types of bioreactors also contributes to higher efficiencies for many types of biocatalytic processes. 25 refs.

5508 Morphology

REFER ALSO TO CITATION(S) 52400

5509 Pathology

REFER ALSO TO CITATION(S) 52223, 52283, 52342, 52422, 52423, 52426, 52431

52318 (BNL—39428, pp A3) **Body composition in acromegaly - before and after therapy.** Brummer, R.J.M.; Bengtsson, B.A.; Isaksson, B. (Sahlgren's Hospital, Gothenburg (Sweden)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Acromegaly is a disease caused by a benign pituitary tumor producing excess amount of growth hormone. A changed body composition can be a functional parameter of the disorder. The aim of this study is to describe body composition in acromegaly before and after therapy. Total body potassium (TBK) was measured as total exchangeable potassium using ^{42}K by dilution technique or by counting gamma radiation from the naturally present ^{40}K in a high sensitivity 3π whole body counter. Total body water (TBW) was determined with an isotope dilution technique using tritiated water as a tracer. The specific activity was measured in urine or plasma. The predicted values for TBK, TBW, and body fat (BF) were calculated by equations using body weight (BW), body height, age and sex as independent variables. The normal values for BW were calculated by using body height and sex as independent variables.

52319 (BNL—39428, pp C6) **Tissue loss during severe wasting in lung cancer patients.** Preston, T.; Robertson, I.; East, B.W.; Fearon, K.C.H.; Calman, K.C. (Scottish Universities Research and Reactor Centre, Glasgow (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Body composition changes have been measured in a small homogeneous group of severely wasted lung cancer patients, as part of an investigation into the mechanism of wasting disease. In vivo neutron activation analysis was used in conjunction with the whole body counting to measure the status of the major body elements Ca, N, P, K, Na, and Cl. Measurements from 6 patients who had lost an average of 29% of their pre-illness weight were each compared with 4 carefully-matched controls chosen from a group of several hundred patients with mild hypertension or hospital outpatients. The mass of major body compartments was calculated in addition to the mass of the major body elements listed above. Total body water was calculated as the sum of intracellular water, measured as the K space, and extracellular water, measured as the Cl space. Fat was derived by difference (weight - lean body mass) after addition of total body water, protein and minerals to calculate the lean body mass. In addition, muscle mass changes were calculated by compartmental analysis of changes in total body N and K. Results show that the average body fat reduction was greater than 80%. Intracellular water reductions were very significant in all patients, but extracellular water mass increased in only 2 patients, the mean change not being significant. Bone minerals decreased significantly in all patients. A major finding of this study was that the significant large reduction of total body N and K in all patients was consistent with the hypothesis that skeletal muscle was the predominant tissue lost from the lean body.

52320 (BNL—39428, pp E4) **Body composition changes in essential hypertension before and after treatment.** Fueloep, T. Jr.; Worum, I.; Csongor, J.; Ujhelyi, L.; Foeris, G. (Univ. Med. Sch., Debrecen (Hungary)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The body composition of 30 elderly (22 females: 78,2+7,6; 8 males: 80,4+5,4 yrs) and 38 middle-aged (27 females: 45,5+10.3; 11 males: 42,3+8,7 yrs) people suffering of essential hypertension determined by complex clinical and biological examinations (BP: 160-180/100-200 Hgmm), was determined before and after treatment. Most of them (78%) could be reassessed after 3 month of treatment (beta-blocking drugs or diuretics). The authors also investigated a few numbers (n=10) of patients presenting a hypertensive crisis treated with vasodilatant drugs and diuretics during 1 week of period. The hormonal status of all of them was assessed at the same time. The body composition was determined by multiple-isotope method.

52321 (BNL—39428, pp P10) **Determination of body composition in elderly subjects suffering of diabetes mellitus and arteriosclerosis.** Worum, I.; Fueloep, T. Jr.; Ujhelyi, L.; Csongor, J. (Univ. Medical School of Debrecen (Hungary)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The authors determined the body composition of 23 diabetic and 36 arteriosclerotic subjects by multiple-isotope method. Their hormonal status was also assessed at the same time. They determined the body composition of well compensated, orally treated diabetic elderly and it was found that the intracellular volumes are unchanged comparing to healthy elderly controls, the total body fat is slightly increased, while the intracellular volumes (except extracellular volume ECV, in the case of females) are diminished signifi-

cantly, mainly, in the case of males. In the case of decompensated diabetes treated originally with insulin, they found a general dehydration affecting mainly the intracellular compartments, but also in a less extent the extracellular ones. After one week of treatment with insulin and perfusions the body composition became normalized. The hormonal changes were not significant. In the case of arteriosclerosis they made a distinction after the dominating signs and symptoms between central peripheral arteriosclerosis. It seems after their results that except a diminution of plasma volume (PV), more marked in central arteriosclerosis, no changes could be observed comparing to health age-matched controls. In conclusion they can say that diabetes in its decompensated form causes a general perturbation of body composition in the sense of dehydration necessitating a well-managed rehydration.

52322 (BNL—39428, pp P11) **Body composition changes in congestive heart failure before and after treatment.** Fueloep, T. Jr.; Worum, I.; Szabo, T.; Foeris, G.; Leovey, A. (Univ. Medical School of Debrecen (Hungary)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The body composition of 50 elderly and 20 middle-aged people presenting the symptoms and signs of congestive heart failure was determined by multiple-isotope method ($^{3}H_2O$; ^{22}Na; ^{35}S; ^{131}I-HSA). In both sexes independently of age the extracellular fluids (extracellular volume ECV; interstitial volume ISV) except plasma volume (PV) were enhanced comparing to controls. The total body water (TBW) did not change, but the intracellular water diminished. The majority of these patients received a combined treatment of diuretics and digitalis, but only a few of them received only digitalis. In the first group, the authors observed a significant diminution of PV, TBW and a less marked diminution of ECV and ISV. Interestingly the ICV diminished further. In the group treated by digitalis alone, the PB did not change, while the TVW, ECV, and ISV enhanced further and the ICV normalized. After 2 weeks of digitalis treatment the ECV and ISV normalized also, while TBW showing a tendency to decrease without normalization. A good correlation was found between the body composition changes and hormonal changes mainly in the case of aldosterone and plasma renin activity. These investigations show that: congestive heart failure cases a redistribution of fluids in favor of extracellular fluids; the combined treatment of diuretics and digitalis is very effective, but if applied too quickly could cause further imbalance in the body composition, and the digitalis treatment alone approach to normal body composition is the best candidates for this type of treatment.

52323 (BNL—39428, pp P12) **Age-related variations in the body composition of patients in maintenance hemodialysis.** Fueloep, T.; Worum, I.; Csongor, J.; Szabo, T. (Univ. Medical School of Debrecen (Hungary)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Total body water (tritiated water), extracellular fluid volume (radiosulfate), exchangeable sodium, (^{22}Na), and plasma volume, (^{131}I) were determined in 96 patients with end-stage renal disease treated on maintenance hemodialysis. The study was aimed at getting objective information about the patient's excess fluids and nutritional state. Intracellular and interstitial fluid volume, red blood cell mass, total blood volume, lean body mass, total body fat, and dry body weight were derived from the measured values. 25 healthy young and 45 healthy elderly volunteers served as control. They were found healthy in a health screening program.

52324 (BNL—39428, pp P13) **Body fluid compartments, hypertension and the renin-angio-tensin-aldosterone system (RAAS) in hemodialysed patients.** Worum, I.; Fueloep, T.; Csongor, J.; Szabo, T. (Univ. Medical School of Debrecen (Hungary)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Total body water (tritiated water), extracellular fluid volume (radiosulfate), exchangeable sodium (^{22}Na), and plasma volume (^{131}I) were determined by means of the modified multiple isotope dilution method of Bauer et al. in 96 hemodialysed patients. Plasma renin activity, angiotensin I, and aldosterone in 43 cases, then solely plasma aldosterone in more 34 cases were measured simultaneously. The interrelationships between body fluid compartments, arterial hypertension and RAAS were investigated. Good correlation was found between arterial blood pressure, ECV and NaE, respectively. In hypertensive patients the volume-pressure-RAAS axis has been changed comparing with normotensive patients: no correlation was found between PRA and arterial blood pressures; there was a good correlation between PRA and plasma K level; angiotensin I showed negative correlation with blood pressures and total blood volume, respectively; and aldosterone did the same with arterial pressures and NaE, respectively.

52325 **Population dynamics of tumors attacked by immunocompetent killer cells.** Hiernaux, J.R.; Lefever, R. (Universite Libre de Bruxelles (Belgium)). pp 19-36 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

The authors discuss the application of a mathematical model of the predator-prey type, which has been adapted to the problems of tumor growth. The use of this model can offer a better grasp of the dynamics of interacting cellular populations. Attention is focused on the tumor dynamical properties resulting from the kinetic interactions by which effector cells destroy cancer cells, rather than of the multiple immunoregulatory processes of the anti-tumor immune response.

52326 **Immune surveillance: towards a tumor-specific model.** Michelson, S. (Rhode Island Hospital, Providence (USA)). pp 37-55 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

Two models of tumor escape from an active anti-tumor response have been developed. The models describe cell populations which exhibit random life lengths distributed in accordance with a gamma distribution. They have been simulated using Monte Carlo techniques which model the life length as a series of maturation chambers each distributed in accordance with an exponential distribution. The malignantly transformed cells are characterized by three binary variables: Escape Route, Target Structure Stability, and End Susceptibility. The simulated results show that the ability of a tumor to escape depends on the activity generated by the immune system in the anti-tumor response. However, tumor escape is also a function of tumor cell type.

52327 **AIDS: background and the dynamics of the decline of immunocompetence.** Merrill, S.J. (Marquette Univ., Milwaukee, WI (USA)). pp 59-75 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

A mixed stochastic-deterministic model of the infection of T4 (helper-inducer) lymphocytes by the HIV virus is proposed. It is used to explore the loss of immunocompetence in AIDS as it is affected by (1) rate of external antigenic stimulation of T4 cells, (2) the effectiveness of defenses and (3) initial size of infection.

52328 **HIV infection from an ecological viewpoint.** McLean, A. (London Univ. (England)). pp 77-84 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

A model is presented which describes the dynamics of a population of T/sub H/ cells in response to infection with HIV.

Preliminary results are presented concerning threshold criteria for the establishment of HIV. A second model is considered which describes the impact of a second replicating pathogen upon an established HIV infection, and, vice-versa, the effect of a new HIV infection upon a pre-existing, persistent infection.

52329 **Analysis of immune system retrovirus equations.** Intrator, N.; Deocampo, G.P.; Cooper, L.N. (Brown Univ., Providence, RI (USA)). pp 85-100 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

An attempt has been made to mathematically model the patterns of viral growth and the associated immune system response characteristically associated with infection by the human immunodeficiency virus (HIV). By employing a very simple model of viral growth and the humoral immune system response, the interaction between a normal virus and the immune system response is compared with that of a viral entity called an immune system retrovirus (ISRV). A model treating the cellular response of the immune system appears to lead to similar results.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 52271, 52273, 52325, 52326, 52327, 52328, 52329

52330 **(DOE/ER/13273—4) Metabolic mechanisms of plant growth at low water potentials: Final report.** Boyer, J.S. (Texas A and M Univ., College Station (USA). Research Foundation). 1987. Contract FG05-84ER13273. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88015784/JAW.

As proposed, we investigated the effects of low water potentials on cell enlargement and photosynthesis. We described a new instrument (a guillotine psychometer) and method for investigating the control of cell enlargement in plants. The method allows all the factors affecting cell enlargement to be evaluated in a single plant sample growing at a steady rate. All the measurements were conducted while the plants were completely intact with the exception of the yield threshold turgor. This parameter was measured within 5-10 min after excision of the enlarging tissue. Because the time is short, the data probably represented the condition in the intact plant just prior to excision. We investigated the effect of leaf magnesium on the photosynthetic response to low water potential because biochemical work from our laboratory indicated that magnesium concentrations slightly above those normally occurring in the chloroplast stroma resulted in an inhibition of photophosphorylation. The inhibition of photophosphorylation by Mg^{2+} was similar to that caused by low water potential is that the ATPase activity of coupling factor (the terminal enzyme for phosphorylation in chloroplasts) was inhibited, the conformation of the purified coupling factor protein was altered, and the changes persisted in vitro. 21 refs.

52331 **(DOE/ER/13776—1) [Metabolic mechanisms of plant growth at low-water potentials]: Progress report.** Boyer, J.S. (Delaware Univ., Newark (USA). Coll. of Marine Studies). 1988. Contract FG02-87ER13776. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016908/JAW.

We used soybean seedlings grown in vermiculite in a dark, humid environment because they are convenient to grow, undergo most of the physiological changes induced by low water potentials in large plants, and have exposed growing regions. We studied how growth-induced water potentials originate; which of the parameters regulating cell enlargement are the cause of the decreased rate of stem growth observed at low water potentials; molecular changes that occur in the cell wall at low water potentials; and the mechanism of differential root and shoot growth at low water potential.

52332 **How immune cells find their targets: quantitative studies of cell adhesion, migration, and chemotaxis.** Lauffenburger, D.; Hammer, D.; Tranquillo, R.; Buettner, H.; Fisher, E. (Univ. of Pennsylvania, Philadelphia (USA)). pp 3-18 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

Many of the critical functions of immune cells require direct contact between these cells and target cells. Rates of these functions may often be limited by the rate of encounter between the cells and targets. Since these rates are key variables in most theoretical analyses of the immune response, fundamental understanding of the underlying processes governing them is of great importance. This paper summarizes the authors recent work directed toward the quantitative analysis of the processes of cell adhesion, migration, and chemotaxis, and their effects on the rates of encounter between immune cells and their targets. Their results should prove to be helpful in improving theoretical understanding of the dynamics of the immune response.

52333 **Models of immunolysis assays: a vesicle-based approach for direct binding.** Waite, B.A.; Chang, E.L. (Naval Academy, Annapolis, MD (USA)). pp 103-117 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

The purpose of this study is to propose a receptor carrier-based approach for studying the effects of ligand/binding interactions for a variety of simple systems, all of which involve monovalent receptor sites embedded within the vesicle membranes. Such an approach ties closely with actual experimental probes, many of which involve nothing more than vesicle-counting methods. If the binding phenomenon of interest manifests itself differently for vesicles bound in distinct ways (e.g., with different numbers of bound ligands or crosslinks per vesicle), then such a model should prove useful for interpreting and verifying certain binding mechanisms as well as effector mechanisms.

52334 **Estimation of antibody affinity via reduced-order modeling.** Hsu, C.S. (Washington State Univ., Pullman (USA)). pp 135-145 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

The objective of this paper is to introduce the notion of reduced-order modeling and to demonstrate its applicability in the estimation of antibody affinity. The author reformulates the problem of determining the affinity distribution into an equivalent problem of identifying a parametric model of a linear system. A numerical procedure to carry out the model identification (or realization) is presented along with computer-simulation results. The concept of system inverse is introduced. Finally, they discuss some possible topics for further immunology-theoretic research in the area of reduced-order modeling.

52335 **Symbolic interpretation of data and the definition of factors in immunogenetics.** Wohlgemuth, A. (Univ. of Maine, Orono (USA)). pp 147-160 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

Contemporary immunogenetics uses a notation that does not allow for the complexity found in biological systems. All attempts at a more general approach to interpreting immunogenetic data have been shown, in one respect, to be mathematically equivalent. The new, more general symbolism admits more interpretations of data than can be handled - even with a computer. The intractable computational questions that have been asked historically are re-

placed by new questions that are more meaningful biologically and more tractable computationally. As an application, data on HLA is interpreted in terms of the new symbolism. The results suggest a genetic model that differs from the currently accepted model. The new model is shown to be more economical in its interpretation of statistical and family (recombination) data.

52336 **Predominant use of the particular V gene in the KLH-specific suppressor T cell family.** Taniguchi, M.; Imai, K.; Koseki, H. (Chiba Univ. (Japan)). pp 179-186 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

Jerne proposed his idiotype network hypothesis to explain how the immune system generates and maintains enormous diversity of antigen-specific lymphocytes. However, there are several questions to be asked if idiotype networks function as the main communication systems in immune responses. Thus, particular idiotype and anti-idiotype sets are only allowed to expand. If this is the case, the idiotype network system can not be generalized. It is necessary to demonstrate how idiotype networks function in conventional antigen systems with multiple epitopes in order to generalize their biological significance. Secondly, it is interesting to known how idiotype networks function in regulatory cell interactions, because enormous negative energy would be necessary to accomplish the effective regulation of immune responses, if the regulatory T cells, like B cells, see every epitope and possess a huge repertoire corresponding to the various epitopes on conventional antigen. Therefore, a more economical system than that of B cells can be expected to exist at the T-cell level to circumvent the above problems. In this paper, they focus on the above-mentioned subjects in the idiotype network hypothesis.

52337 **Control of lethal autoreactivity without a network.** Rammensee, H. pp 207-212 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

One mechanism for the induction of self-tolerance is clonal deletion of self-reactive T cells in the thymus. It is not known whether this is sufficient to maintain self-tolerance in the periphery. To be sufficient would require the absence of somatic variation of T cell receptor (TCR) genes in peripheral T cells, of extrathymic differentiation of T cells, and of any leakiness of the thymus negative selection process. Rather than testing directly whether these requirements are fulfilled, they have studied how self-reactive T cells would be handled when introduced artificially into a normal mouse. In order to make it easier to understand the design of the crucial experiments to be described, the author shall briefly explain the veto mechanism, a particular phenomenon of suppression which has been implicated in the induction and/or maintenance of self-tolerance.

52338 **Categories of idiotope overlap and anti-idiotypic mimicry of antigen.** Greenspan, N.S.; Roux, K.H. (Case Western Reserve Univ., Cleveland, OH (USA)). pp 215-231 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

The authors main purpose will be to analyze, and hopefully clarify, the concept of anti-idiotypic mimicry. In their view, current classification schemes for anti-Ids fail to adequately define the properties required for an anti-Id to be labeled an internal image of some antigen. They will apply to this analysis a perspective developed through the attempt to map Ids on the surface of an immunoglobulin variable domain. There are three potential relationships between any pair of Ids expressed by an Ab: (1) the sites are identical, (2) the sites are completely distinct and independent, and (3) the sites are overlapping. Consideration of the meaning of the third category, idiotopic overlap, provided the primary stimulus for the argument developed.

52339 **In search of T-cell help for the internal image of the antigen.** Celada, F. (Hospital for Joint Diseases, New York, NY (USA)). pp 233-245 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

Experiments were performed to trace the T epitopes (HD) of an idiotype internal image of a well-studied antigen. The author outlines a strategy to understand which are the relevant HD for internal image antigen vaccine and, in particular, whether internal images may present HD cross reaction with the original antigen.

52340 **Symmetry and asymmetry in the immune network.** Nesterenko, V.G. (N. F. Gamaleya Institute for Epidemiology and Microbiology, Moscow (USSR)). pp 247-264 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

An attempt has been made to examine the symmetrical and asymmetrical transmission of a stimulus in the immune network. These investigations have shown that it is possible to predict the direction of transmission of the signals and the intensity of the non-specific reaction between immune network levels. It has been shown that asymmetry in transmitting a stimulus to lower and higher immune network levels is determined by: (1) the different spatial localization of some paratopes and Id; (2) possible non-identical affinity of such paratopes and Id on the same receptor for the complementary sites; and (3) populational differences in affinity for the complementary segments in the paratopes and Id that belong to different receptors at the same immune network level.

52341 **Symmetric idiotypic networks: connectance and switching, stability, and suppression.** De Boer, R.J. (Univ. of Utrecht (Netherlands)). pp 265-289 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

A network model is presented that incorporates: (1) symmetric idiotypic interactions, (2) an explicit affinity parameter (matrix), (3) external (i.e., non idiotypic) antigens, (4) idiotypic stimulation at low population densities, and (5) idiotypic suppression at high densities. Such an idiotypic network of two clones has three stable states: a virgin state, i.e., an equilibrium between the normal influx and turnover of cells, and two immune states (one for each clone), which are maintained by idiotypic interactions. In its immune state, a clone suppresses its idiotypic partner and immediately rejects antigen. Introduction of antigen into the virgin state causes a state switch to the corresponding immune state: antigens are thus remembered, i.e., the network displays memory. This symmetric network cannot account for suppression of proliferating clones. They next analyze 50-dimensional (50-D) networks of this same model. The network connectance crucially determines the behavior of the network. Only weakly connected networks know a 50-D virgin state in which all clones are in a resting state. Switching behavior only occurs in weakly connected systems.

52342 **N-dimensional network.** Hoffmann, G.W.; Kion, T.A.; Forsyth, R.B.; Soga, K.G.; Cooper-Willis, A. (Univ. of British Columbia, Vancouver (Canada)). pp 291-319 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

The symmetrical network theory is proving to be a fertile framework for encompassing diverse immunoregulatory phenomena. The authors describe here a refinement of the mathematical model that they have formulated, propose a way of adding the lymphokine IL-1 to the model, discuss the I-J paradox and a related autoimmunity theory of AIDS, and finally, describe some new ex-

perimental results concerning autoimmunity and anti-idiotypes, that were obtained while working within the framework of the symmetrical network theory.

52343 **Computations in shape space: a new approach to immune network theory.** Segel, L.A.; Perelson, A.S. (Weizmann Institute of Science, Rehovot (Israel)). pp 321-343 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

This study is based on the use of generalized shape as the fundamental variable to characterize the binding properties of antigens, antibodies, receptors, etc. Within this framework the investigation concentrates on a network view of the immune system with particular stress on the effects of cross-reactivity. The schematic model considered postulates cells whose probability of entering a proliferative state depends on the interplay of activating and suppressing factors, which in turn are functions of the degree of binding to corresponding sets of receptors. A one-dimensional shape space is considered. Emphasis is placed on the likelihood that the unstimulated immune system is resistant to perturbation, but not too resistant (control vs stability tradeoff). Such a nearly unstable immune system is constructed with the aid of activation that is relatively short range (i.e., relatively specific in binding) compared to suppression. Surprisingly, it is found that instability, or near-instability, can also occur when activation is relatively long range. Various computer simulations illustrate the properties of the model, for example, focusing or defocusing of the antigenic input.

52344 **Polydispersity in immune networks.** Percus, J.K. (New York Univ., NY (USA)). pp 345-358 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

A general model of the operation of a mammalian immune system is developed, in which particular attention is paid to the existence of a very large number of related components. By bunching together lymphocytes, accessory cells, and biochemical messengers into functional units, a simplified description is proposed for the proliferation of these units, depending upon their binding interactions. A toy model prepared in this context has a repertoire in close correspondence with expected properties of such a system. Several extension of the model are described.

52345 **Cognitive networks: immune, neural, and otherwise.** Varela, F.J.; Coutinho, A.; Dupire, B.; Vaz, N.N. (CREA, Paris (France)). pp 359-375 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

There is a strong intuitive sense in which immune systems are cognitive: they recognize molecular shapes, remember the history of encounters of an individual organism, define the boundaries of a molecular self, and make inferences about molecular species likely to be encountered. The first intention of this paper is to argue that by so doing one is leaving unexamined and shrouded in a fog of mystery the most interesting domain of phenomena the immune system affords to animals: their cognitive abilities. A second intention of this paper is to further clarify for cognitive scientists how immune systems can provide a distinctly different class of network architecture also capable of sophisticated cognitive performances. Immune nets merit to be examined on their own as a separate large class next to neural networks. They provide some minimal context for the recent development in cognitive networks which allows them to phrase immune events in a sharper focus. They propose what immune networks are, including their most relevant dynamics in the form of a model. Finally, they derive some conclusions.

52346 **Toward a realistic model of the immune system.** Perelson, A.S. (Los Alamos National Lab., NM (USA)). pp 377-401 of Theoretical immunology, Part 2: Proceedings. Perelson, A.S. (ed.). Redwood City, CA; Addison-Wesley Publishing Company, Inc. (1987). (CONF-8706304—Pt.2).

From Theoretical immunology workshop; Santa Fe, NM, USA (1 Jun 1987).

Using idiotypic networks as an example, the author proposes an approach to developing realistic models of the immune system. He shows that systems containing large numbers of different clones, with particular clones being created and destroyed, can be studied by means of computer simulation. By labeling B cell clones and the antibodies that they secrete by a binary string, and using rules of complementarity between binary numbers, he shows that one can create complex models with realistic topologies. He points out that the language of graph theory may be useful in characterizing idiotypic networks. He also gives an example of a dynamical system of equations, involving antibody, B cell clones and growing antigen that incorporates many of the features of T-independent immune responses. To fully specify these dynamical equations, many important problems in the chemistry of multicomponent mixtures of anti-idiotypic antibodies, B cell receptors and antigen need to be solved. By viewing the immune system as a dynamic entity, whose components may continually be created and destroyed, a new view of the immune system emerges.

5520 Public Health

REFER ALSO TO CITATION(S) 50604, 52165, 52173, 52448

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 50514, 50956, 50957, 50960, 50968, 50969, 50980, 51988, 52256, 52330, 52331

52347 **(INIS-BR—1232) Differential densitometry in radiographies, comparative study in osteotomies.** Louzada, M.J.Q.; Paulin, J.B.P.; Xavier, C.A.M. (Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Medicina). 1985. 1p. (In Portuguese). (CONF-8509458—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704024/JAW.

From 9. Brazilian congress on biomedical engineering; Campinas, Brazil (3 Sep 1985).

52348 **(INIS-BR—1237) Irradiation effects on the duration of intermolt in nymphs of the fourth instar of Panstrongylus megistus Burmeister, 1835 (Hemiptera: Reduviidae).** Barros Falcao, P.H. de. (Universidade Federal Rural do Rio de Janeiro (Brazil)). 1987. 44p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704124/JAW.

The duration of intermolt, in nymphs of the fourth instar, of P. megistus, submitted to irradiation with Cobalt 60, 24 hs after the blood meal is studied. The insects were divided in four groups of 40 and were irradiated with doses of 10, 20, 40 and 80 Gray, respectively. (M.A.C.).

52349 **(INIS-BR—1239) Influence of intake of different levels of phosphorus on the disappearance of /sup 32/P from plasma of sheep.** Lemos, Joaquim W. (Sao Paulo Univ., Piracicaba (Brazil). Escola Superior de Agricultura Luiz de Queiroz). 1982. 105p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704126/JAW.

Six sheep are submitted to diets with three levels of phosphorus: 0.69, 2.72 and 4.65 g/day, during 13 weeks. After this period, 1 ml of radioactive solution of Na/sub 2/H/sup 32/PO/sub 4/ with 150 μli of /sup 32/P is injected intravenously and samples of blood are collected at intervals of 5, 10, 20, 30, 40, 50, 60, 120 and 240 minutes. The activity of radiophosphorus in the plasma is determined by Cerenkov effect. The remaining dose and the evaluation of the nutritional state of the animal are studied. (M.A.C.).

52350 (INIS-mf—11309, pp 147-148) **Portable NMR spectrometer for automatic measurements in plants.** Jager, P.A. de; Reinders, J.E.A.; Polder, G.; As, H. van. (Landbouwuniversiteit Wageningen (Netherlands)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52351 (INIS-mf—11309, pp 72) **Interaction of lac repressor headpiece with its operator. A two-dimensional NMR study.** Boelens, R.; Lamerichs, R.M.J.N.; Rullmann, T.; Kaptein, R. (Rijksuniversiteit Utrecht (Netherlands)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

52352 **(TAEK-BKB—1) Control of important stored pest sitophilus granarius with gamma radiation.** Ozbek, N.; Tuncbilek, A.S.; Toraman, S. (Ankara Nuklear Tarim Arastirma Merkezi (Turkey)). 1986. 25p. (In Turkish). (TAEK-BAI—11). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703942/JAW.

This study was carried out to determine susceptibility of Sitophilus granarius (L.) to gamma radiation at all the developmental stages and to evaluate dose level for effective control. During experiment to grain weevils were reaced and maintained on Sivas bread wheat at 26 C and 70 per cent relative humidity. Irradiation was carried out between 0-100 krad doses and totally 22 different radiation doses were applied.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 52415, 52435

52353 **(BARC—1382) Radiosensitization of hypoxic bacterial cells and animal tumours by membrane active drugs and hyperthermia.** Singh, B.B.; Srinivasan, V.T.; Shenoy, M.A.; George, K.C.; Maniar, H.S.; Rawat, K.P. (Bhabha Atomic Research Centre, Bombay (India). Biology and Agriculture Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704075/JAW.

The present report deals with the results on phenothiazine derivatives such as promethazine (PMZ), trimeprazine (TMZ), trifluoperazine (TFP) and prochlorperazine (PCP) and their comparison with that of chlorpromazine (CPZ). Their efficiency in combination with hyperthermia, radiation and other anti-cancer drugs in treating murine tumors has also been presented herein. In addition, results on bacterial cells dealing with their mechanistic aspects are also included. (author). 57 refs., 27 figures, 13 tables.

52354 (BNL—39428, pp P9) **Analytical signals from cancer patients following radiation treatment.** Wielopolski, L.; Meek, A.G.; Reinstein, L.E. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Cancer patients are treated with high energy (8 to 30 MeV) gamma radiation. This treatment modality provides better depth dose distribution than more conventional low-energy gamma treatments, in particular for deeply located tumors. A by-product of the high-energy treatment is gamma-induced activity in the treatment volume following photonuclear reactions. These reactions are endogenic and require that the gamma radiation energy be above threshold value in order for the reaction to take place. For most elements, the threshold value is above 8 MeV; however, for low Z elements, this threshold may reach 18 MeV as is the case for oxygen. The cross sections for the (γ, n) reactions are few millibarns for low Z elements and increases up to few hundreds of millibarns for the heavy elements. The radionuclides resulting from photonuclear reaction are typically positron emitter or decay by electron capture. Thus, it is possible to monitor either the annihilation radiation (511 KeV) or the characteristic gamma radiation. The present work demonstrates that the activity induced in cancer patients following a single treatment (300 rad) enables the monitoring of nitrogen and phosphorus in the irradiated volume. The results from measurements in phantom, cadavers, and cancer patients from different regions in the body are presented. The hypothesis to be tested is whether there are local changes in these two elements during the course of radiation treatment which might correlate with the efficacy of the treatment.

52355 **(CNIC—00099) Report on 3-year medical follow-up of a case recovered from acute severe bone marrow type radiation sickness.** Li Yanyi; Ji Yinghui; Yang Zhanshan. (Suzhou Medical Coll., JS (China)). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 8p. (In Chinese). (SMC—0013). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704097/JAW.

On September 1, 1980, a 25-year old worker was accidently exposed by a high-intensity /sup 60/Co source of approximate 206 x 10/sup 13/ Bq. An acute bone marrow-type radiation sickness was observed after an accidental nonuniform gamma-ray irradiation. The estimated equivalent whole-boby uniform irradiation dose was 5.22 Gy. The patient survived and was followed up for a period of 3 years from 1981 to 1983. The patient has been recalled at intervals of one year for routine examinations and hematological, biochemical, cytogenetic and ophthalmological examinations and special tests. The patient was examined most recently in July 1983.

52356 **(CNIC—00128) Study on the accumulation of /sup 147/Pm in tissues and its mutagenic effect on bone marrow cells.** Zhu Shoupeng; Zheng Siying; Wang Chongdao; Cao Genfa. (Suzhou Medical Coll., JS (China)). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 7p. (In Chinese). (SMC—0016). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704105/JAW.

The purpose of this study is to ascertain the correlation between the retentive peculiarity of /sup 147/Pm and its possible mutagenic effect in organism administered once or for consecutive 5 days. After /sup 147/Pm was given iv for once to male rats, it was selectively localized in liver in early stage. 5 days later, /sup 147/Pm was located in skeleton predominantly. It caused marked chromosome aberrations on bone marrow cells. There was positive relationship between chromosome aberration rates and the amount of /sup 147/Pm administered. When /sup 147/Pm was administered for consecutive 5 days, it was firstly and chiefly localized in skeleton. The retention data were well described by a two exponential expressions. Retentive T/sub 1/2/ ranged from 5.89 d for the first component to 1155 d for the second slow component. Biological T/sub 1/2/ in urine for the slow component was 121.58 d. These data pointed out that the excretion of /sup 147/Pm was slow. Among the types of aberration induced by /sup 147/Pm were of chromatid type. Chromatid deletions were predominant, accompanied with a few chromosome aberrations.

52357 (CONF-760202—, pp 191-193) **Radiation exposures aboard commercial aircraft.** Uselman, J.; McKlveen, J.W. (Arizona State Univ., Tempe (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

An initial study was conducted to determine the type and amount of radiation received aboard commercial flights. Stewardess volunteers carried thermoluminescent dosimeters for six weeks. Whereas no manmade radiation sources were positively identified, exposures from cosmic rays ranged from 0.1 to 1.4 mR/hr and the average of 0.3 mR/hr.

52358 (CONF-760202—, pp 194-198) **Occupational training in the health physics curriculum.** Vetter, R.J.; Ziemer, P.L. (Purdue Univ., West Lafayette, IN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

In response to projected demands for health physics personnel with field training at the bachelor's degree level, the Bionucleonics Department has revised its curriculum in Radiological Health to provide applied training in health physics. The basic program provides a strong background in math, physics, chemistry and biology and an in-depth background in the fundamentals of health physics and field training in applied health physics. The field training is also open to graduate students. The field exercises are coordinated with Purdue's Radiological Control Program and include such tasks as contamination and direct radiation surveys; facility and personnel decontamination; reactor, accelerator, and analytical and diagnostic X-ray monitoring; instrument calibration; personnel monitoring; and emergency planning and accident evaluation. In a weekly discussion period associated with the field exercises, the students evaluate their field experience, discuss assigned problems, and receive additional information on regulations, regulatory guides, and management of radiation protection programs.

52359 (CONF-760202—, pp 203-205) **Radiation health training at Colorado State University.** Zelle, M.R.; Johnson, J.E. (Colorado State Univ., Fort Collins (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The Department of Radiology and Radiation Biology of the College of Veterinary Medicine and Biomedical Sciences at Colorado State University has developed strong programs in four areas; veterinary radiology, radiation biology including cellular and molecular radiation biology, environmental radiation-radiation ecology, and radiological health or health physics.

52360 (CONF-760202—, pp 221-226) **Radiation monitor training program at Rocky Flats.** Medina, L.C.; Kittinger, W.D.; Vogel, R.M. (Rockwell International, Golden, CO (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The Rocky Flats Radiation Monitor Training Program is tailored to train new health physics personnel in the field of radiation monitoring. The purpose of the prescribed materials and media is to be consistent in training in all areas of Rocky Flats radiation monitoring job involvement.

52361 (CONF-760202—, pp 247-249) **Safe handling of radioiodinated solutions.** Howard, B.Y. (Univ. of Virginia, Charlottesville (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

An incident of contamination of personnel with radioiodine prompted a re-examination of procedures for handling radioiodinated solutions. Iodide ion can be oxidized in solution to elemental iodine, which has a low solubility in water. Safe handling procedures for shipping containers and radioiodine solutions to minimize airborne and surface contamination include the use of a ventilation hood and gloves. Bioassay of personnel helps to detect contamination.

52362 (CONF-760202—, pp 425-430) **Need for quality assurance in diagnostic radiography.** Bunge, R.E.; Gross, R.E.; Vucich, J.J.; Barnett, M. (Food and Drug Administration, Rockville, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The wide variation in patient exposure for the same examination at different facilities, as shown by the Nationwide Evaluation of X-Ray Trends (NEXT) data, has been previously reported. This paper presents further analysis of NEXT data collected from 15,000 surveys of medical and dental radiographic installations in the United States. Large variations in standardized machine output (mR/mAs at 12 inches at identical kVp) are seen and in many cases high patient exposure correlates with above-average machine output. Additional parameters affecting patient exposure and radiographic quality, including film-screen combinations, grids, and film processing are explored through the use of other data bases. This analysis of the data partially explains the side variation in radiologic practices and patient exposure and suggests a need for quality assurance efforts by health physicists in medical facilities. Several Bureau of Radiological Health projects in the field of radiologic quality assurance are summarized.

52363 (CONF-760202—, pp 431-435) **Recognizing action levels during NEXT surveys of diagnostic X-ray systems.** Luckett, L.W. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Implementation of the Nationwide Evaluation of X-Ray trends (NEXT) program has provided radiation safety program managers with data and analysis to identify those diagnostic x-ray systems which produce seemingly higher than necessary patient exposures. However, much time and emphasis is lost by the weeks of deadtime normally required for analysis of the data and identification of any hazardous systems. A method is described which permits the surveyor to rapidly and easily recognize predetermined action levels at the time the exposures are made during the survey. This identification of questionable systems while the surveyor is still at the facility enables added emphasis to be placed on further investigations of corrective actions necessary to reduce patient exposure during diagnostic x-ray examinations.

52364 (CONF-760202—, pp 450-456) **Operational health physics at the Los Alamos Meson Physics Proton Accelerator.** Engelke, M.J. (Univ. of California, Los Alamos, NM (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

This paper addresses the operational health physics practices and procedures at the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF); a medium energy, high intensity proton accelerator. The operational philosophy used for control of personnel exposures and radioactive materials is discussed. A particular operation involving the removal of a radioactive beam stop reading in excess of 1000 R/h is described.

52365 (CONF-760202—, pp 457-461) **Average neutron measurements at an accelerator facility, a practical health physics problem.** Miller, A.J. (Univ. of California, Los Alamos, NM (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Surveys designed to estimate the average energy of neutrons escaping from shielded enclosures have been made at the Clinton P. Anderson Meson Physics Facility (LAMPF). Information obtained from these data has proven of value in establishing response factors for the personnel monitoring dosimeters (NTA film) worn by LAMPF associated personnel. The value of measuring average neutron energies was demonstrated about one year ago when the monthly film badge report indicated significant neutron exposures to personnel of an experimental group at LAMPF. Neutron radiation-survey data, as well as recorded data from area monitoring stations, indicated much lower personnel neutron doses. Subsequent average neutron energy measurements, at the location of interest, revealed a well-defined region where average neutron energies were considerably greater than previously measured in other occupied areas of the accelerator facility. This paper addresses the rationale for the decision to alter the NTA film response factor, from

that normally applied to the LAMPF badges, for these experimenters.

52366 (CONF-760202—, pp 468-474) **Dose levels due to neutrons in the vicinity of high energy medical accelerators.** McGinley, P.H., Wood, M.; Sohrabi, M.; Mills, M.; Rodriguez, R. (Georgia Institute of Technology, Atlanta (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

High energy photons are generated for use in radiation therapy by the decelleration of electrons in metal targets. Fast neutrons are also generated as a result of (γ, n) and (e, e'n) interactions in the target, beam compensator filter, and collimator material. In this work the adsorbed dose to neutrons was measured at the center of a 10 x 10 cm photon beam and 5 cm outside of the beam edge for a number of treatment units. Dose levels due to slow and fast neutrons were also established outside of the treatment rooms and a Bonner sphere neutron spectrometer system was employed to determine the neutron energy spectrum due to stray neutron radiation at each accelerator. For the linac it was found that the neutron dose at the beam center was 0.0039% of the photon dose and values of 0.049% and 0.053% were observed for the Allis Chalmers betatron and the Brown Boveri Betatron. Dose equivalent rates in the range of 0.3 to 22.5 mrem/hr were measured for points outside the treatment rooms when the accelerators were operated at a photon dose rate of 100 rad/min at the treatment position.

52367 (CONF-760202—, pp 480-485) **Radiation protection aspects of a high flux, fast neutron generator.** DeLuca, P.M.; Torti, R.P.; Chenevert, G.M.; Tesmer, J.R.; Kelsey, C.A. (Univ. of Wisconsin, Madison (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

During the development and operation of a gas target, DT neutron generator for use in cancer therapy, two radiation hazards were routinely encountered - personnel exposure to neutrons and to tritium. The principal hazard was irradiation by fast neutrons. By assembling the source below ground level, adding shielding and the use of a controlled access, key identification interlock, the neutron hazard has been reduced. With the present source strength of 2 x 10^{12} n/sec, an average neutron dose rate in the control room of 20 mrem/hr was measured- a level compatible with a limited run schedule. The second hazard was exposure to tritium in both gaseous and solid forms. A target inventory of 90 Ci, and overall inventory of 500 Ci, and the need to modify and repair the generator present significant potential hazard due to tritium exposure. The use of protective gloves, wipe tests, urine assays, continuous room air monitoring, and equipment decontamination minimized personnel exposure and effectively confined contamination. The dose due to tritium has been ~ 0.5 rem/year and negligible spread of contamination has occurred.

52368 (CONF-760202—, pp 499-508) **Health physics aspects of the Yale Heavy Ion Linear Accelerator dismantling project.** Price, K.W.; Holeman, G.R. (Yale Univ., New Haven, CT (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A program for the disassembly of the Yale Heavy Ion Linear Accelerator was initiated January 1, 1975. The object of the disassembly was to render the accelerator complex free of radioactive contamination in order that the area may be used for other University purposes. In addition, any salvage of metal parts was a desirable goal of the dismantling procedure. A systematic removal of all contaminated material began immediately. Portable survey instruments, swipe surveys, and sodium iodide gamma ray spectra were used as indicators of contamination. Apparatus in the direct beam line seemed to pose the most significant hazard to personnel. As beam components were eliminated, radioactive contamination was significantly reduced. Certain accelerator parts had to be machined in order to salvage non-contaminated metal, and the health physics aspects of this procedure are described. Isotopes found in the surveys included ^{22}Na, ^{54}Mn, ^{60}Co, ^{65}Zn and ^{75}Se, which were predominately beam activation products of accelerator components. Final surveys indicated the area free of radioactive contamination.

52369 (CONF-760202—, pp 509-511) **Radiation control during the dismantling of a 22 Mev cyclotron.** Dumas, D.; Killian, C.; Labenski, T.; Brantley, D. (New England Nuclear Corporation, Boston, MA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The problem with the cyclotron became apparent when the operators found great difficulty in obtaining an adequate, operational vacuum. After all possible causes were investigated, the replacement of the inner 0-rings was decided to be the only solution. This paper covers the pre-planning and training thought to be necessary to complete the procedure as quickly and safely as possible. The main objective is to show that exposure can be kept to a minimum with proper forethought and supervision.

52370 (CONF-760202—, pp 523-528) **Occupational exposure estimates for plutonium fuel conversion and fabrication operations.** Mulkin, R.; Mayfield, D.L.; Graf, J.M. (Univ. of California, Los Alamos, NM (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Estimates have been made for occupational exposure associated with operation of two commercial scale production plant models, one a plutonium conversion plant and the other a mixed oxide fuel fabrication plant. The estimates were made by visualizing production and support operations through the viewpoint of a production manager responsible for scheduling and determining manpower requirements. Model plants were described in terms of design basis radiation zones and contamination zones. Control levels for airborne activity appropriate for plutonium operations were used to develop airborne concentrations. Airborne concentration and dose rates were folded with occupational residence times in each type of zone to generate occupational dose figures. The integrated dose for each occupational group was summed to generate a number for the plant population. Results were 300 man rem per year external exposure for the conversion plant, and 350 man rem per year external exposure for the fabrication plant. Average annual internal dose was greatest for the lung and was found to be 0.16 and 0.19 rem per man at the respective plants.

52371 (CONF-760202—, pp 562-567) **Detection of internally deposited actinides part I: studies on the ORNL phoswich system.** Good, W.M.; Goans, R.E. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The authors have obtained correlated time and energy spectra for the ORNL phoswich system in order to better establish and control the instrumental parameters. The phoswich, in principle, utilizes phosphor decay times to differentiate between pulses from the phoswich's thin NaI(T1) detector and its thick CsI(Na) mantle. At ORNL these times are represented by the intervals between the leading edge and the cross-over points of the amplified pulses. Time analysis is via a time-to-pulse-height converter and multi-channel analyzer. The spectral responses were obtained for background and the sources ^{60}Co and ^{239}Pu. To assist in the interpretation of these phoswich spectra, an exactly equivalent set of measurements was performed using a simple bare thin NaI(T1) detector. From the results obtained, procedures were derived for establishing and maintaining the phoswich's time gate. Other results show that the effectiveness of the phoswich's background cancellation diminishes with pulse height; and there is a suggestion that this degree of cancellation may be a quality factor for the phoswich which may, like resolution, deteriorate with time.

52372 (CONF-760202—, pp 568-573) **Detection of internally deposited actinides part II: statistical techniques and risk analysis.** Goans, R.E. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Since a considerable number of workers at Oak Ridge National Laboratory work with compounds of transuranic elements, computer techniques have been developed to evaluate phoswich spectra in order to determine lung burdens following accidental inhalation of ^{239}Pu, ^{241}Am, ^{244}Cm or other isotopes. Two unfolding methods which have been found useful in the analysis of such cases are presented and discussed. These techniques have been used successfully to detect low levels of ^{239}Pu, ^{241}Am, ^{244}Cm, ^{235}U, ^{90}Sr, and ^{153}Gd in contaminated workers; but because of the current importance of ^{239}Pu, emphasis is placed on detection of that isotope in the presence of ^{241}Am and natural human background. In the health physics tradition of emphasizing benefit vs. risk, the authors also analyze uncertainties inherent in external counting of the actinides from the viewpoint of statistical risk analysis an derive decision criteria which are useful in determining whether various radioactive species have, in fact, been detected. These criteria are somewhat different from those encountered using traditional counting statistics and derive from the realization that some errors will always be made in scanning large numbers of radiation workers. The optimum decision strategy for the determination of lung burden is, therefore, one which minimizes the long-term risk of error. The usefulness of this approach to whole body counting will be discussed and analyzed.

52373 (CONF-760202—, pp 574-577) **Detection of internally deposited actinides part III: recent background studies at ORNL.** Good, W.M.; Bemis, C.E.; Goans, R.E. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

It has been apparent from accumulated data at ORNL that the low-energy (< 100 keV) phoswich background spectrum in the iron-shielded counting facility has components, possible including a line below 15 keV, whose magnitudes show considerable variability. The authors have used a planar intrinsic Ge detector designed especially for measuring low-energy photons for background study as part of an evaluation of such a device for in vivo ^{239}Pu measurement. The spectrum that was observed consisted of a continuum upon which were superimposed discrete lines including a strong line at 10.35 keV in addition to the well-known lines from Pb X rays. Detectable also were X rays that corresponded to K-lines of several of the products of the naturally occurring radioactive decay series. Background spectra are presented and the implications of their variability are discussed.

52374 (CONF-760202—, pp 582-587) **Evaluation of two cases of ^{244}Cm inhalation.** Parkinson, W.W.; Henley, L.C.; Goans, R.E.; Good, W.M. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Chest and systematic burdens have been estimated for two employees who inhaled largely soluble compounds of ^{244}Cm. Chest burdens by whole body counting were: Case A, 28 nCi; Case B, 34 nCi. The urinary excretion of the employees appeared to conform to a series of exponentials similar to those reported for blood and whole body retention of Am in baboons. Accordingly, retention functions composed of a series of exponentials having 4, 12-17, and 72 day half-times were derived from urinary excretion and used to calculate body burdens, Case A - 7 nCi an Case B - 16 nCi. Cumulative fecal excretion by Case B was some 20 times that by Case A (63 nCi vs. 3.2) probably due to differences in deposition in the respiratory tract. Calculated organ doses for the first year were approximately 20% of recommended maxima.

52375 (CONF-760202—, pp 588-594) **Estimation of dose commitment from an accidental intake of ^{244}Cm.** Bernard, S.R.; Poston, J.W. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Four employees at the Oak Ridge National Laboratory experienced an intake by inhalation of ^{244}Cm as a result of an accidental release of this radionuclide. Urine and fecal samples were obtained and were analyzed in the Bioassay Laboratory at ORNL. Also, chest counts were made with ORNL Whole Body Counter. Ca-DTPA mists were inhaled within hours after the intake. These data together with the data of the McClellan et al. on the inhalation of ^{244}Cm in the dog were used to obtain a 50-year dose commitment to lungs, skeleton, and liver. The 50-year dose commitment to skeleton for two of the employees is estimated to be about 170 rem. The estimation methods for dose commitment together with the values for other organs obtained are presented and discussed.

52376 (CONF-760202—, pp 595-599) **Graphic display of internal doses from multiple uptakes of radionuclides.** Wenzel, D.R. (Allied Chemical Corporation, Idaho Falls, ID (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Personnel routinely working in a contaminated area may receive small uptakes of radionuclides. The amount and behavior of the inhaled and/of ingested radionuclides can be established from a bioassay and in vivo measurements. The dose evaluation of the uptake becomes complex when there are several radionuclides involved and when multiple exposures are experienced over a long period of time. A computer is used to calculate the dose and to display graphically the dose received by an organ as it is accumulated along with the projected dose. This paper presents graphic displays of actual multiple internal doses received by a radiation worker and presents the techniques used to calculate and display the doses.

52377 (CONF-760202—, pp 600-605) **Determination of criteria for a bioassay program.** Olson, O.L. (University of Missouri, Columbia (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Bioassay sampling to monitor internal deposition has long been a conventional practice to evaluate risk of exposure. Within the university, bioassay sampling must be limited to that for which there is a convincing need. The Nuclear Regulatory Commission (NRC) has begun to insist on bioassay sampling for contact levels that are unnecessarily low, which places the health physicist in the untenable position of requiring bioassay samples on the technically unsatisfactory basis of it's the law. It is recommended that bioassay monitoring be performed: (a) when an individual is processing quantities of tritium in excess of ten times the Maximum Permissible Body Burden (MPBB) of non-volatile activity under conditions where airborne contamination cannot be controlled and (b) when an individual is processing quantities of tritium in excess of 1000 times the MPBB of any form activity in equipment with air control provided by a functioning fume hood following appropriate health physics evaluation. Other radionuclides are considered.

52378 (CONF-760202—, pp 606-611) **Field surveys of uranium miners for the in vivo detection of ^{210}Pb.** Pomroy, C. (Department of National Health and Welfare, Ottawa, Ontario (Canada)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The properties of the phoswich (double crystal) detector suggest that it could be suitable for the detection of ^{210}Pb in the skulls of active uranium miners, using a mobile laboratory. A pilot study was set up to investigate the feasibility of such a method, and the possibility of using the measurements as an index of cumulative inhalation of radon and daughters. Three 12.5 cm diameter phoswich detectors were installed inside a lead brick enclosure in a

mobile laboratory, and taken to two different mines, where a total of 40 subjects was measured. No ^{210}Pb was detected in any of the subjects, but the level of detection was not low enough for this result to be of great significance. This was due to the high background counts in the areas of the surveys, and the inadequacy of the transportable shielding. Contamination of the miners with short-lived daughter products was also a problem. It is concluded that the method is useful only in a steel room when sufficient time has elapsed for this short-lived contamination to have disappeared. It is suggested that measurement of blood samples may be suitable as a monitoring or screening test.

52379 (CONF-760202—, pp 612-616) **Effect of particle size and translocation class on calculated doses from plutonium to lung and other organs.** Watson, E.C.; Strenge, D.L. (Pacific Northwest Labs., Richland, WA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Inhalation is the primary exposure pathway to man following the atmospheric release of plutonium. The Task Group Lung Model, TGLM, has been incorporated in a computer program, DACRIN, which calculates the dose to lungs and other organs. Examination of the effect of particle size and translocation class on the calculated doses from plutonium and ^{241}Am to lung, bone, liver and gastro-intestinal tract shows that translocation class has a greater effect on calculated doses than particle size for particle sizes with an activity median aerodynamic diameter within the range of 0.05 μm to 5 μm.

52380 (CONF-760202—, pp 617-620) **In-vivo measurements of gamma emitters using the National Institutes of Health Whole Body Counter.** Rumble, W.; Aamodt, R.; Johnston, G.S. (National Institutes of Health, Bethesda, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Since 1961 the N.I.H. Whole Body Counter has been monitoring personnel who use gamma-ray emitting radioisotopes. Six thousand determinations have been performed since 1964, 3600 in the past three years. Two measurement techniques are used for determination of gamma-ray activity of N.I.H. personnel. Total body activity is determined using a modified 60 cm. arc with two 8 x 4 in. NaI(T1) scintillation detectors positioned over the mid-point of the arc. Thyroid activity is measured by a collumnated probe detector consisting of two 2 x 2 in. aluminium clad detectors positioned 1.5 in. from the neck over the thyroid. Both detector systems are located in a low background counting room. In the past three years, N.I.H. laboratories have received 727 Curies of various radionuclides of which 574 Curies were gamma emitters. Tc-99m comprises 70% of all activity used; three quarters of which goes to the Nuclear Medicine Department. Most frequently, personnel determinations have been for I-125, I-131, Cr-51, Tc-99m, and Ga-67. Of the 3600 determinations performed in the past three years, 60% were thyroid measurements for I-125 and I-131; of these 44% indicated activities above 1 nCi and 13.4% were above 10 nCi. Total body measurements accounted for the remaining 40% with 21.5% of these indicating activity above 1 nCi and 15.4% above 10 nCi.

52381 (CONF-760202—, pp 621-626) **Differences in the biological half lives of inhaled Co-58 and Co-60.** Rosen, J.C.; Sabo, A.T. (Univ. of Pittsburgh, PA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

In-vivo measurements were initiated 4 days following an airborne exposure to highly contaminated radioactive debris. The material was produced in an explosive plugging operation in a nuclear steam service system. The nuclides of primary concern were Co-60 and Co-58. Total body scans obtained on days 4 and 39 indicated that the primary site of deposition was the chest. Early clearance was complete by day 6. From day 6 through day 200 only single component exponential clearance functions were observed. The effective half lives for clearance are estimated to be 57 days and 3.9 years for Co-58 and Co-60, respectively. The corresponding biological half times are 280 days and 14 years. The shorter biological clearance rate for Co-58 was confirmed by limited excreta analyses. Reasons for the separation of the two cobalt isotopes are discussed. The effects of long biological clearance times and separation of isotopes on exposure evaluation and dose commitment are considered.

52382 (CONF-760202—, pp 647-653) **Analysis of facility design and operation for maintaining personnel exposures as low as reasonably achievable.** Coco, L.M. (Westinghouse Electric Corporation, Pittsburgh, PA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Increasing NRC emphasis on maintaining personnel exposures as low as reasonably achievable (ALARA), has resulted in much confusion and discussion of the subject. Health physicists in operating facilities and designers of new facilities are faced with the responsibility of developing and/or implementing programs which will maintain personnel exposures ALARA, but have been given little regulatory guidance. Although several cost-benefit approaches have been recommended and general regulatory guidelines put forth in Regulatory Guide 8.8, the actual mechanics of situation analysis has not been clarified. The author has developed an ALARA program which, when used in conjunction with facility design and/or operation, anticipates potential problem areas and can contribute in reducing the total plant man-rem dose. The program provides the mechanics for analysis and evaluation of potential hazards, shielding and process design, and personnel usage.

52383 (CONF-760202—, pp 654-659) **Numerical criteria for in-plant as low as is reasonably achievable.** Mauro, J.J.; Porrovecchio, J. (Ebasco Services Incorporated, New York, NY (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Due to the differences in the dose distributions as a function of age between the general population of radiation workers, the calculated number of adverse effects per man rem in-plant is 63% of the calculated number of adverse effects per man rem off-site. This ratio could be applied to off-site numerical criteria for as low as is reasonably achievable to obtain in-plant criteria.

52384 (CONF-760202—, pp 660-671) **Auditable program of compliance with ALAP.** Munson, L.H.; Freytag, L.A. (United Nuclear Industries, Inc., Richland, WA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Increasing public and governmental pressure is being felt by all sectors of the Nuclear Industry to demonstrate compliance to maintaining occupational radiation exposures as low as practicable (ALAP). This paper describes a systematic approach to occupational radiation exposure reduction which will not only reduce radiation exposure usage but will provide an auditable record of compliance with ALAP. The essential features of the program include guidelines for: 1) identification and appreciation of tasks which use significant amounts of radiation exposure, 2) the contribution of the Health Physicist in reducing radiation exposure usage, and 3) a matrix for evaluation of feasibility, practicality and economics of each application.

52385 **(CONF-870163—3) Cancer induction: The influence of dose and LET.** Fry, J.M. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 8p. (CONF-870163—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015284/JAW.

From DOE/CEC workshop on mechanisms of radiation interaction with DNA; San Diego, CA, USA (21 Jan 1987).

We are concerned with estimates of risk of radiation-induced damage. For radiation protection purposes the risk estimates of cancer induced by low-LET radiation have been based on human data. In the case of ICRP's risk estimates for cancer mortality two

assumptions are made: (1) the effect per rad for the induction of leukemia is less at low doses than at high doses by a factor of 2.5, and (2) that 5 times more solid cancers than leukemia will be induced by whole-body exposures to low-LET radiation. The influence of results from experimental data on ICRP's or other risk estimates has been limited to supporting the concept that the dose-response curves for at least some cancers are curvilinear and, can be adequately described by the so-called linear quadratic model. The approach to the estimate of risks is first, a pragmatic approach involving direct determinations. Since data at low doses and low-dose rates are difficult to obtain, estimates of the effects at low doses involve extrapolation. In order to extrapolate some model of the dose response must be assumed. The selection of an appropriate model depends an understanding of the mechanisms. The second approach is the study of the mechanisms.

52386 (EGG-FSP—8036) **Internal dose conversion factors for 19 target organs and 9 irradiation times and external dose-rate conversion factors for 21 target organs for 259 radionuclides produced in potential fusion reactor materials.** Fetter, S. (EG and G Idaho, Inc., Idaho Falls (USA); Harvard Univ., Cambridge, MA (USA). Center for Science and International Affairs). Mar 1988. Contract AC07-76ID01570. 399p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88015204/JAW.

Estimating radiological risks is an essential part of an assessment of fusion's potential to fill a niche in world energy supply, but many of the radionuclides that may be produced in fusion reactors have not been considered previously. In an effort to supply the basic data necessary to assess the radiological hazards of fusion, this report presents estimates of internal dose conversion factors (DCFs) and external dose-rate conversion factors (DRCFs) for 259 radionuclides, many of which may be important in fusion reactor materials. Five exposure modes are considered for each radionuclide: internal exposure from inhalation and ingestion, and external exposure to contaminated air, surface, and soil. For internal exposure, DCFs are computed for nineteen target organs and nine irradiation times; for external exposure, DRCFs are computed for twenty-one target organs. For many radionuclides, this report represents the only listing of DCFs and DRCFs for individual organs or for irradiation times of less than fifty years. 15 refs.

52387 (INIS-mf—11696, pp 23-24) **Exposure to natural radiation from the earth's crust, atmosphere and outer space - some fundamental facts and figures.** Wirth, E. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Geographisches Inst.). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

By law of nature, all living organisms are exposed to ionizing radiation in terms of terrestrial radiation or cosmic rays which, for man, result in an average total annual exposure rate between 100 to 150 mrem. A health hazard for the human body cannot be verified beyond doubt. This is exemplified by the average natural radiation exposure in Bavaria.

52388 (INIS-mf—11696, pp 45-55) **Exposure to natural radiation from the atmosphere and outer space.** Endlicher, W. (Freiburg Univ. (Germany, F.R.). Inst. fuer Physische Geographie). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

Annual radiation exposure by the impact of natural radionuclides results from both internal and external radiation exposure. The latter comprises the total of terrestrial, atmospheric and cosmic rays which make up the total exposure of gonads, bones, lungs and bronchi. In central Europe, mean total radiation exposure is estimated at ca. 120 mrem/a, or 170 mrem/a, or 1,200 mrem/a for gonads, bones, or lungs, respectively.

52389 (INIS-mf—11696, pp 57-73) **Effects of radioactivity on the living organism.** Sauer, R. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Klinik und Poliklinik fuer Strahlentherapie). 1987. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754314/JAW.

Erlanger Forschungen. Reihe B. Naturwissenschaften und Medizin.; v. 17.

In Natural and artificial radioactivity in the environment. A stocktaking before and after Chernobyl.

Genetic radiation effects were never observed in man and do not figure greatly as a radiation hazard at low dose levels. Somatic radiation effects, i.e. the hazard of cancer induction, are the major risk factors. Teratogenic radiaton effects have no pathological impacts before the ninth day of pregnancy. Within the following five weeks, 50 rem will double the spontaneous malformation rate. Low-level radiation doses exhibit a positive effect (hormesis) on metabolism, inflammatory processes and degenerative diseases.

52390 (NCRP—92) **Public radiation exposure from nuclear power generation in the United States.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 30 Dec 1987. 213p. National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814. Order Number TI88015589/JAW.

This report presents estimates of public radiation exposures from nuclear power generation in the US during the early 1980s. The entire light water reactor (LWR) nuclear fuel cycle is considered, from mining of uranium ore to disposing of radioactive wastes. The radiation dose equivalents given here are based on reviews made by various governmental organizations. Dose estimates are calculated for the individuals in the general population who may receive the maximum exposure and for the population within 80 km of facilities that are typical of those in operation during the early 1980s. These estimates are for routine operations, which are taken to include certain abnormal occurrences described as "anticipated operational occurrences," and from accidents and incidents during transporation. The estimates do not include radiation doses from major accidents, from decommissioning nuclear facilities, or from research and development facilities. Fuel reprocessing and high-level waste disposal are discussed although neither is part of the US fuel cycle at this time. 232 refs.

52391 (NEI-NO—52, pp 21) **Internal transmission of dispersed radiation through the neck.** Aagaard, A. (Copenhagen Univ. (Denmark)). 1986. (In Danish, English, Norwegian, Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754749/JAW. (CONF-8605348—).

From Nordic symposium on biomedical radiography in odontology; Bergen, Norway (29 May 1986).

52392 (NUREG/CR—5198) **Inhaled $^{239}PuO_2$ and/or total-body gamma radiation: Early mortality and morbidity in rats and dogs.** Filipy, R.E.; Decker, J.R.; Lai, Y.L.; Lauhala, K.E.; Buschbom, R.L.; Hiastala, M.P.; McGee, D.R.; Park, J.F.; Kuffel, E.G.; Ragan, H.A.; Cannon, W.C.; Yaniv, S.S.; Scott, B.R. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 301p. (PNL—6586). NTIS, PC A14/MF A01 - GPO. Order Number TI88016197/JAW.

Rats and beagle dogs were given doses of ^{60}Co gamma radiation and/or body burdens of $^{239}PuO_2$ within lethal ranges in an experiment to determine and compare morbidity and mortality responses of both species within 1 year after exposure. Radiation-induced morbidity was assessed by measuring changes in body weights, hematologic parameters, and pulmonary-function parameters. Gamma radiation caused transient morbidity, reflected by immediately depressed blood cell concentrations and by long-term loss of body weight and diminished pulmonary function in animals of both species that survived the acute gamma radiation syndrome. Inhaled plutonium caused a loss of body weight and diminished pulmonary function in both species, but its only effect on blood cell concentrations was lymphocytopenia in dogs. Combined gamma irradiation and plutonium lung burdens were synergistic, in that ani-

mals receiving both radiation insults had higher morbidity and mortality rates than would be predicted based on the effect of either kind of radiation alone. Plutonium lung burdens enhanced the effect of gamma radiation in rats within the first 30 days of exposure, and gamma radiation enhanced the long-term effect of plutonium lung burdens in both species. Rats were less sensitive to both kinds of radiation, whether administered alone or in combination. 71 refs., 105 figs., 48 tabs.

52393 (OEFZS—4451, pp 9) **Hierachy of genome resistance systems to radiation damage.** Korneyev, N.A.; Sarapultsev, B.I.; Geraskin, S.A.; Alexakhin, R.M. (The All-Union Research Institute of Agricultural Radiology, Obinsk (USSR)). Jun 1988. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52394 (OEFZS—4451, pp 23) **Comparison of cytogenetic tests for monitoring overexposures from ionizing radiations.** Koeteles, G.J.; Kormos, C. ('Frederic Joliot-Curie' National Research Institute for Radiobiology and Radiohygiene, Budapest (Hungary)). Jun 1988. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52395 (OEFZS—4451, pp 5) **Radiation-induced gene amplification in mammalian cells.** Luecke-Huhle, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Jun 1988. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52396 (OEFZS—4451, pp 7) **Inducible processes in DNA replication and repair after γ-, uv-irradiation and action of some chemicals on mammalian cells.** Saenko, A.S.; Syzynys, B.I.; Trofimova, S.F.; Zamulaeva, I.A.; Smirnova, S.G.; Orlova, N.V.; Brozmanova, J.; Pelevina, I.I. (Research Institute of Medical Radiology of AMS, Obninsk (USSR); Cancer Research Institute of the Slovak Academy of Sciences, Bratislava (Czechoslovakia); Institute of Chemical Physics, Moscow (USSR)). Jun 1988. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52397 (OEFZS—4451, pp 21) **Sister chromatid exchanges and inhibition of DNA synthesis in irradiated human cells.** Pleskach, N.M.; Andriadze, M.I.; Mikhelson, V.M.; Zhestianikov, V.D. (Institute of Cytology, Academie Science USSR, Leningrad (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52398 (OEFZS—4451, pp 27) **Effect of ionizing radiation on unscheduled DNA synthesis (UDS) in human and murine lymphocytes.** Liu, S.Z.; Sun, J.B.; Li, X.Y. (Bethune (N.) Medical Univ., Changchun, JL (China)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52399 (OEFZS—4451, pp 29) **DNA repair in cells of C/sub 57/bl mice after radiation and in vivo treatment with a DNA site modulator of poly(ADP-ribose)-polymerase.** Altmann, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52400 (OEFZS—4451, pp 37) **Differentiation control in cell cycle and development based on the alterations of higher order chromatin structure. Theory and application to radiation and chemical actions.** Andreev, S.G. (Moscow Ingeneering Physics Institute, Moscow (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52401 (OEFZS—4451, pp 39) **Supervision of cellular response to radiation by human interferon.** Suzuki, N.; Suzuki, H. (Chiba Univ. (Japan). School of Medicine; Tokyo Metropolitan Research Lab. of Public Health (Japan)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52402 (OEFZS—4451, pp 41) **Effect of epidermal growth factor and insulin on the kinetics of radiation-induced DNA lesions repair.** Bildin, V.N.; Seregina, T.B.; Zhestyanikov, V.D. (Institute of Cytology of the Academy of Sciences of the USSR, Leningrad (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52403 (OEFZS—4451, pp 44) **Mutagenic damage from radiation and certain chemical via clastogenic factors. Protection by superperoxide dismutase.** Emerit, I. (Paris-6 Univ., 75 (France)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52404 (OEFZS—4451, pp 48) **Influence of chromatin structural organization on neutron and γ-irradiation cytogenetic effects.** Bogatykh, B.A.; Golub, E.V. (Institute of Medical Radiology at the USSR Academy of Medical Sciences, Obninsk (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52405 (OEFZS—4451, pp 52) **Modification in G/sub 2/-phase of the realization of chromosomal aberrations of human lymphocytes induced by irradiation in G/sub 0/-phase.** Ryabchenko, N.I.; Izmailova, N.N. Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52406 (OEFZS—4451, pp 57) **Studies of the radiation-induced chromosomal abnormalities in sister cells: a new regularities of realization of chromosome structural alterations.** Zhloba, A.A.; Sevankaev, A.V. (Research Institute of Medical Radiology, Academy of Medical Sciences of the USSR, Obninsk (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52407 (OEFZS—4451, pp 2) **Ionizing-radiation-induced genetic damage to natural populations and processes of adaption.** Shevchenko, V.A. (USSR Academy of Sciences, N.I. Vavilov Institute General Genetics, Moscow (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52408 (OEFZS—4451, pp 53) **Correlation between radioresistance of chronically irradiated populations of higher and lower plants and DNA repair.** Shevcenko, V.A.; Semov, A.S.; Sergeeva, S.A.; Ptitsina, S.N. (USSR Academy of Sciences, N.I. Vavilov Institute General Genetics, Moscow (USSR)). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52409 (OEFZS—4451, pp 4) **Continous induction of unscheduled DNA synthesis by gamma irradiation.** Weniger, P.; Klein, W.; Ott, E.; Kocsis, F.; Altmann, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52410 (OEFZS—4451, pp 6) **Cytological analysis of radiation-induced gene amplification in C57BL/6 mice.** Mukherjee, U. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52411 (OEFZS—4451, pp 20) **Sister chromatid exchanges in lymphocytes of persons exposed to low levels of ionizing radiation.** Tuschl, H. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Jun 1988. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW. (BL—729/88; CONF-880754—).

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

52412 (ORAU—88/C-68) **The federal ionizing radiation research agenda related to low level biological effects, FY 1985.** Mossman, K.L.; Flack, D.S.; Geiger, L.F.; Mills, W.A. (Oak Ridge Associated Universities, Inc., TN (USA)). Mar 1988. Contract AC05-76OR00033. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88014091/JAW.

The Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) was established on April 9. 1984 and chartered under the Federal Coordinating Council for Science, Engineering and Technology, Office of Science and Technology Policy, Executive Office of the President. Its overall charge is to coordinate radiation matters among agencies, evaluate radiation research, and provide advice on the formulation of radiation policy. Technical assistance to the Committee is provided by Oak Ridge Associated Universities (ORAU). The present report is divided into four sections with two appendices, mentioned above. Section A is an introduction to there report and provides the specific charges from CIRRPC to ORAU to conduct the study. Section B addresses how the federal radiation research agenda for FY85 met the research needs specified in the 1981 Strategy Report. The last section of the report, Section D, offers the following recommendations with regard to future reports: (1) Within the next three years, a follow-up review should be made of the Federal radiation research program, including comparisons with the FY81 and FY85 Federal radiation research agendas; (2) To facilitate subsequent reviews of the Federal radiation research programs, it is recommended that, to the extent it is practical, a compatible information retrieval system be established in each Federal agency; (3) A report of the Federal radiation research effort in high dose radiation effects should be carried out since substantial Federal funding is used to support such research and since many studies are applicable to both the high and low dose radiation research agendas. 2 figs., 23 tabs.

52413 (OUP—88-14) **UV-radiation and skin cancer dose effect curves.** Henriksen, T.; Dahlback, A.; Larsen, S.H. (Oslo Univ. (Norway). Fysisk Inst.). Aug 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754753/JAW.

Norwegian skin cancer data were used in an attempt to arrive at the dose effect relationship for UV-carcinogenesis. The Norwegian population is relatively homogenous with regard to skin type and live in a country where the annual effective UV-dose varies by approximately 40 percent. Four different regions of the country, each with a broadness of 1/sup o/ in latitude (approximately 111 km), were selected . The annual effective UV-doses for these regions were calculated assuming normal ozone conditions throughout the year. The incidence of malignant melanoma and non-melanoma skin cancer (mainly basal cell carcinoma) in these regions were considered and compared to the annual UV-doses. For both these types of cancer a quadratic dose effect curve seems to be valid. Depletions of the ozone layer would result in larger UV-doses which in turn may yield more skin cancer. The dose effect curves suggest that the incidence rate will increase by an "amplification factor" of approximately 2.

52414 **Pluripotent stem cells with normal or reduced self renewal survive lethal irradiation.** Brecher, G.; Neben, S.; Yee, M.; Bullis, J.; Cronkite, E.P. (Lawrence Berkeley Lab., Berkeley (USA)). *Experimental Hematology;* **16**: No. 7, 627-630(Aug 1988).

Transfusion with 10,000 or 20,000 marrow cells resulted in 30+ days survival of 15%-50% of mice exposed to an Ld90 or LD100 or radiation. The use of congenic mice with alloenzyme markers permitted the identification of host and donor cells in the peripheral blood of transfused animals. Donor cells were present initially in all hosts. Between 55% and 92% of the animals became 100% host type by 12-24 weeks after transfusion in three separate experiments. To explore whether the temporary repopulation by donor cells was due to short-lived stem cells, the marrows of several primary hosts were transfused into secondary, lethally irradiated hosts. Some of the retransplanted primary donor and host cells persisted only temporarily. It is suggested that some of the donor stem cells in both the primary and secondary hosts had an intrinsically shortened life span.

52415 **Radiation research: Volume 2.** Fielden, E.M.; Fowler, J.F.; Hendry, J.H.; Scott, D. (eds.). London, England; Taylor & Francis (1987). 1002p. Unlimited audience, publicly available. Taylor and Francis Ltd., 4 John Street, London WC1N 2ET. Order Number TI88014026/JAW. Contract FG03-87ER60499.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

The Eighth International Congress of Radiation Research was held at Edinburg. Of the 1350 delegates from 37 countries who attended, some 1165 submitted an abstract and made a poster or verbal presentation of their work. The abstracts of all scientific presentations, including the symposium talks and Congress lectures, have been bound and appear as Volume 1 of the Proceedings, which thus comprises a complete, albeit abbreviated, record of the scientific content of the Congress. The texts of the Congress lectures and symposium talks are presented in this, Volume 2 of the Proceedings, which provides an overview of the current concerns and developments in all aspects of radiation research throughout the world. In presenting these papers the editors have grouped them under eight subject headings.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 51736, 52150, 52293, 52312

52416 (BNL—39428, pp D1) **In vivo monitoring of trace elements in medicine and research.** Chettle, D.R.; Scott, M.C.; Ellis, K.J.; Morgan, W.D. (Univ. of Birmingham (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

This paper will survey recent developments in measurements of cadmium and lead in vivo, for which techniques have been available for about a decade, with a view to demonstrating the contribution such studies have made to research in occupational medicine and toxicology. Salient features of contrasting techniques will be drawn out so as to highlight their respective strengths and weaknesses. This will include comparison of neutron activation analysis and x-ray fluorescence for cadmium measurement, together with discussion of the choice of source in neutron activation systems. The different, and sometimes conflicting, claims of precision and accuracy will be discussed. In the case of lead, attention will focus on variations among x-ray fluorescence techniques. Recent advances which promise to extend the range of elements of interest in occupational medicine accessible to in vivo measurement will be considered. The present status of analytical techniques for mercury, beryllium, silicon and silver will be reviewed, and likely future development discussed. Other trace elements, whose measurement will be discussed, are platinum, iron, copper, lithium and strontium. The varying fields of application for these analyses will be indicated, and the techniques already applied to the in vivo analysis of these elements will be considered.

52417 (BNL—39428, pp D2) **X-ray fluorescence technique for in vivo analysis of natural and administered trace elements.** Mattsson, S.; Christoffersson, J.O.; Jonson, R. (Univ. of Goeteborg (Sweden)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

During recent years there has been a growing interest to use X-ray fluorescence techniques for the in vivo measurements of trace elements (Pb, Cd, and Hg) in the body. A variety of radionuclide and X-ray sources as well as irradiation and detection geometries have been used. In practically all in vivo situations one has to measure close to the detection limit of the technique which means that there is a real need to optimize and continuously improve the technique. The adsorbed dose to the patient during a typical measurement which lasts 20-40 minutes is normally very low. The paper will briefly review the technique and applications used for in vivo studies in man and finally present the authors recent data from in vivo measurements of platinum following cisplatin therapy.

52418 (BNL—39428, pp D3) **In vivo measurements of Pt and Pb in patients undergoing cis-Pt chemotherapy.** Morgan, W.D.; El-Sharkawi, A.M.; Jaib, M.; Evans, C.J.; Cobbold, S.; Sivyer, A.; Littlepage, B.N.C.; Dutton, J. (Univ. College of Swansea, Wales (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

An apparatus employing the method of x-ray fluorescence analysis has been developed which is capable of measuring the uptake of platinum in the kidneys and superficial tumor sites of patients receiving cis-Pt chemotherapy. This enables pharmacodynamic information to be obtained directly, thereby increasing the potential for improving the effectiveness of drug dosage regimens. A pilot study in 20 patients is in progress, in which Pt retention and distribution will be related to mode of administration and indices of nephrotoxicity. In three out of the first 10 patients, lead was also found unexpectedly in the kidney. In two of these cases, the uptake was massive ($\sim$ 1000 $\mu g\ g^{-1}$) and in the third (in whom no lead had been observed prior to treatment) it was an order of magnitude smaller. All three patients had employment histories involving exposure to lead, although the one with the lowest result was only marginally exposed. In one of these patients, Pb exposure was confirmed by a tibia measurement using the ^{109}Cd system. A value of 95 $\mu g\ g^{-1}$ was recorded. Subsequently, the tibia Pb was measured in the other high exposure patient by the Swansea group and found to be 30$\mu g\ g^{-1}$. These findings suggest that body lead stores may be mobilized by cis-Pt chemotherapy and that renal uptake of lead may be hitherto unrecognized contributory factor of the nephrotoxicity of Pt compounds.

52419 (BNL—39428, pp D4) **X-ray fluorescence of lead in vivo: simultaneous measurement of a cortical and trabecular bone in a pilot study.** Somervaille, L.J.; Chettle, D.R.; Scott, M.C.; Krishnan, G.; Browne, C.J.; Aufderheide, A.C.; Wittmers, L.E.; Wallgren, J.E. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Following the development and successful application, of an in vivo x-ray fluorescence technique to measure lead in the tibia shaft, the method was extended to include a simultaneous measurement of the lead concentration in calcaneus. This method, in which the 88 keV γ-rays from ^{109}Cd excite the lead K series x-rays, can now be used to obtain the lead concentration in both cortical (tibia) and trabecular (calcaneus) bone. As with the tibia measurement, the lead x-ray signal is normalized to a concentration in bone by means of the coherently scattered photon signal. The accuracy of this procedure was tested by comparing the results of x-ray fluorescence (XRF) and atomic absorption spectroscopy (AAS) measurements on 44 bone samples - a section of tibia shaft and the calcaneus from each of 22 subjects. The mean differences (XRF-AAS) in lead concentration (μg Pb (g bone ash)$^{-1}$) were; for the tibia -1 +/- 2 (SEM), and for the calcaneus 2 +/- 5(SEM).

52420 (BNL—39428, pp D5) **Linear model describing the kinetics of lead in occupationally exposed workers.** Christoffersson, J.O.; Schutz, A.; Skerfving, S.; Ahlgren, L.; Mattsson, S. (Lund Univ., Malmo (Sweden)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

During recent years the authors have studied occupationally exposed lead workers. The lead concentration in different tissues, predominantly in bone and blood, has been determined. Using these data a linear three-compartment model for the kinetics of lead have been developed. More than 90% of lead in the body is to be found in bone. The kinetics of lead in cortical and trabecular bone differ. Therefore, two of the compartments consists mainly of trabecular and cortical bone respectively. The third compartment consists of blood and soft tissues. Using this model levels of lead in bone and blood can be predicted on a group basis.

52421 (BNL—39428, pp D6) **Longitudinal survey of exposure to cadmium fumes - preliminary findings from in vivo body burden measurements.** Franklin, D.M.; Guthrie, C.J.G.; Scott, M.C.; Chettle, D.R.; Mason, H.J.; Smith, N.J.; Blindt, M. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Members of a work force exposed to cadmium fumes during the production of brazing alloys had in vivo liver and kidney cadmium measurements made in 1981. The factory was revisited in 1986 when repeated measurements of both liver and kidney cadmium were obtained on 16 individuals; for a further 5 workers repeat measurements of only liver cadmium were acquired. Analysis of the results lent support the suggestion made previously that cadmium is redistributed from liver to kidney some time after initial exposure and to the observation of an association between a low ratio of kidney cadmium to liver cadmium and renal dysfunction. The results of the in vivo monitoring also contributed significantly to advice concerning future exposure to those still engaged in the cadmium-silver alloy production.

52422 (BNL—39428, pp D8) **Body lead burden, II: environmental lead and end-stage renal disease.** Wedeen, R.P.; Batuman, V.; Schidlovsky, G.; DeBore, M.E.; Van de Vyver, F.; Visser, W.G. (V. A. Medical Center, East Orange, NJ (USA)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Approximately 200,000 Americans are currently afflicted with end-stage renal disease (ESRD) at a cost exceeding 2 billion dollars, however, fewer than 10% of ESRD cases are characterized etiologically. Among these, lead nephropathy is unique in that it is not only preventable but also reversible by EDTA Pb chelation therapy. Since over 95% of body Pb is stored in bone the application of rapid, non-invasive measurement of bone Pb by in vivo X-ray fluorescence (XRF) offers the opportunity to perform epidemiological studies of the association of the body Pb burden with an increased risk of ESRD. Five preliminary studies performed over the past two years in a collaboration of the VA with the University of Antwerp and Brookhaven National Laboratory support the conclusion that tibial XRF of chronic hemodialysis patients and case matched controls can establish the impact of body Pb burden on ESRD.

52423 (BNL—39428, pp D9) **Bone aluminum measurements in patients with end-stage renal disease.** Ellis, K.J.; Kelleher, S.P. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Long-term use of aluminum-based phosphate binders and trace aluminum contamination of dialysate solution have led to increased body burden of this metal in patients with end-stage renal disease. Aluminum accumulates in bone and has been associated with the development of a renal osteodystrophy, called aluminum-induced osteomalacia. At present, bone biopsy is the method of diagnosis of this condition. When examined by quantitative histomorphometry, the aluminum accumulation was reported to correlate with the severity of the osteomalacia. This project was therefore undertaken to investigate the possibility of developing a non-invasive technique using neutron activation analysis for the direct in vivo assessment of bone aluminum levels. A bilateral exposure of the patient's hand is performed at the patient port of the Brookhaven Medical Research Reactor. The induced activity is then counted for 5 min using four 4" x 4" x 16" NaI(T1) detectors arranged in a quasi-4! geometry. In addition to Al, Ca is also detected and serves as each individual's internal standard for the volume of bone mass irradiated. The Al/Ca ratio provides an index of the amount of elevated aluminum per unit bone mass. When this ratio is multiplied by the total body calcium value, an estimate of total skeletal aluminum is obtained. These measurements will be presented for a pilot study of ten asymptomatic renal patients.

52424 (BNL—39428, pp P22) **Feasibility study for the in vivo measurement of beryllium by photonuclear activation.** Ali, P.A.; Dutton, J.; Evans, C.J.; Morgan, W.D.; Sivyer, A. (Univ. College of Swansea, Wales (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Diagnosis of the beryllium-induced disease, berylliosis, is often difficult and always requires that the presence of the metal in tissue be demonstrated. The feasibility of developing an in vivo method of measurement, which exploits the uniquely low photonuclear reaction threshold of 1.67 MeV in beryllium, has been investigated. Suitable photon sources and detector systems were assessed, both experimentally by phantom studies and theoretically by use of a Monte Carlo neutron transport code. It is concluded that by using a filtered source of ^{124}Sb for bilateral irradiation of the chest, and an array of twenty BF_3 counters, a detection limit of 0.67 +/- 33 mg of beryllium per lung could be achieved for a skin dose of 50 mGy delivered within a period of 90 seconds. Such a facility would be capable of contributing to the etiology of the disease in a large proportion of cases, but the wider use of the method for screening exposed workers would require further improvements in detection efficiency.

52425 (BNL—39428, pp P23) **In vivo measurement of organ mercury by prompt gamma activation analysis using a mobile nuclear reactor.** Chang, P.S.; Chung, C. (Kaohsiung Medical College, Taiwan, (China)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The in vivo measurement of mercury in kidney is explored by detecting prompt γ-rays emission after neutron absorption. The neutrons are provided from a low-power mobile educational reactor. The kidney phantom is filled with $HgCl_2$ solution, and prompt γ-rays are collected by a 59.4 cc portable HPGe detector. The detection limit of Hg in the left kidney for a skin dose of 23.9 mSv (2.39 rem) is 58 +/- 8 ppm under 7200 s irradiation/counting. Finally, the possible ways and tests of reducing detection limit and irradiation/counting time are discussed.

52426 (BNL—39428, pp P24) **In vivo measurement of silicon in the lung and other body elements, using fast neutron inelastic scattering reactions.** Dutton, J.; Evans, C.J.; Kacperek, A.; Sivyer, A.; Morgan, W.D. (Univ. College of Swansea (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

Silica dust inhalation by industrially exposed personnel can lead to serious lung disease, in particular silicosis. The quantitative measurement of lung silicon would be useful in the study of the silica exposure and patient symptoms relationship. Previous work has shown that the fast neutron inelastic scattering reaction $^{28}Si(n,n'\gamma)^{28}Si$ emitting 1779keV γ-rays is most suitable for Si measurement having a higher cross-section than other neutron-silica reactions. This technique is being developed further by the use of 5.2 MeV neutrons produced via the D-D reaction by a 2MV Van de Graaff generator accelerating deuterons on to a deuterated-Ti target. A 5MeV incident neutron energy has the advantage of corresponding to the maximum cross-section of the silicon inelastic scattering reaction and avoiding the interference from identical γ-rays from the $^{31}P(n,\alpha)^{28}Al$ reaction which becomes significant above 5MeV. Pulsing the neutron flux also improves sensitivity by separating in time the prompt inelastic γ-rays from those emitted by slow neutron capture reactions, and measuring only during the neutron burst.

52427 (BNL—39428, pp P25) **Body lead burden, I: validation of rapid, non-invasive, in vivo bone lead determination by X-ray fluorescence.** Jones, K.W.; Schidlovsky, G.; Wedeen, R.P.; Batuman, V. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The observation that over 95% of body Pb is stored in bone with a biological half-life of about 10 years prompted the development of several variations of non-invasive, in vivo detections schemes based on X-ray fluorescence (XRF) in bones. The authors approach is to expose the human tibia bone for 30 mins. to the 88 KeV gamma rays from a 50 mCi ^{109}Cd source and record simulta-

neously the fluoresced Pb K X-rays and elastically scattered photons from bone Ca and P with a planar Ge(Li) detector. The ratio of PbK to elastic events (the latter is a measure of bone mass from which the PB signal arises) can then be converted to absolute Pb ppm values for any wet or dry bone parameter on the basis of known physical and biological characteristics of the system. Calibration was accomplished with plaster of Paris phantoms doped with known concentrations of Pb acetate, with 8 random amputation legs and 22 clinical patients.

52428 (BNL—39428, pp P26) **In vivo assessment of inhaled iron-bearing lung contaminants using fast neutron inelastic scattering and remanent magnetic field measurements.** Kacperek, A.; Rassi, D.; Evans, C.J. (Univ. College of Swansea (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

This present study aims to use two techniques to provide an index of iron-dust burden in the lung. In vivo neutron activation analysis can provide a quantitative measure of elemental iron in the human chest. When this iron is in magnetic form, measurement of the remanent magnetism following external field magnetization can also be related to dust deposition in the lung. Fast neutron irradiation of iron produces 847 keV γ-rays by the $^{56}Fe(n,n'\gamma)^{56}Fe$ inelastic scattering reaction. Fast neutrons are produced with a 2MeV Van de Graaff accelerator, by the $^{2}H(d,n)^{3}He$ reaction. The iron γ-rays are measured by two large HPGe detectors (34% and 29% relative efficiency respectively). Decreasing the incident neutron energy below the energy threshold of competing reactions also helps in reducing background. The present detector arrangement and a neutron dose-rate equivalent (Q.F. = 10) of 10 mSv x h^{-1} is estimated to yield a detection limit better than 200 mg of iron. Although this limit must be improved before normal lung iron burdens can be measured, it is quite suitable for organs in which disease states cause iron overloads of several grams to occur.

52429 (BNL—39428, pp P27) **Longitudinal study of ex-employees of a Ni-Cd battery company.** Morgan, W.D.; Cobbold, S.; Ryde, S.J.S.; Ghose, R.R.; Ali, P.A.; Birks, J.L.; Sandhu, S.; Hainsworth, I.; Braithwaite, R. (Univ. College of Swansea (England)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The aim of this study is to measure kidney and liver cadmium levels by in vivo neutron activation analysis and to relate these values to biochemical and physiological indices of renal function. By repeating these measurements over a period of many years it is hoped to identify the critical parameters at the point when renal dysfunction might first be observed. The study protocol includes blood and urine analyses of urea, creatinine, protein, calcium, amino acids and B_2-microglobulin; an isotopic test of glomerular filtration rate and effective renal plasma flow; single photon absorptiometry of the distal radius; and where possible separation and identification of urinary and plasma metallothionein. In addition, all subjects are asked to complete a questionnaire relating to employment history, diet and smoking habit.

52430 (BNL—39428, pp P28) **In vivo measurement of Li.** Vartsky, D.; LoMonte, A.; Ellis, K.J.; Yasumura, S.; Cohn, S.H. 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

This paper describes a neutron activation method for the in vivo determination of Li in humans, with a particular emphasis on its distribution in brain. The method is based on the production of tritium (T) when a neutron is captured by a ^{6}Li nucleus present in the body. A fraction of the tritium produced is exhaled from the lungs in HT form. After the separation of HT from other gases present in breath, its activity is measured in a low-background proportional counter. The amount of activity should be proportional to the Li present in the irradiated organ.

52431 (BNL—39428, pp P29) **Particle-induced X-ray emission analysis of trace elements in human brain tumors.** Wei, C.C.; Chen, S.Y.; Castro-Magana, M.; Chou, M.J.; Chien, C.H. (Tsing Hua Univ., Hsinchu, Taiwan (China)). 1986. NTIS, PC A05/MF A01. Order Number DE87006750/JAW. (CONF-8609203—Absts.).

From International symposium on in-vivo body composition studies; Upton, NY, USA (28 Sep 1986).

The authors have been using particle-induced X-ray emission (PIXE) in cancer research for some time and atomic absorption spectrophotometer, fluorometer to assay trace elements in selenium treated rats. In this contribution they report the relative elemental weight distribution in human brain tumors measured PIXE method. The results are compared with those of healthy brains and discussed from the point of view of metal carcinogenesis and pathology.

52432 (DOE/ER/60158—3) **Environmental carcinogens in human target tissues in culture: Progress report.** Hsu, I.C. (Maryland Univ., Baltimore (USA). Dept. of Pathology). 21 Jan 1987. Contract AS05-83ER60158. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015782/JAW.

We have accumulated more experimental evidences that demonstrated the comparative approaches with human cells will allow us to predict human risk with good accuracy following exposure to toxic chemicals. We also synthesized several carcinogenic DNA adducts, i.e., the major benzo[a]pyrene DNA adduct, 0^{6}-methyldeoxyguanosine, 7-methyl- deoxyguanosine and 2-methyldeoxyguanosine to be used as standards for quantitating DNA adduct formation in carcinogen exposed cells. A simple synthetic method was developed for preparation of the major B[a]p DNA adduct with yields better than those reported. The main accomplishments related to the originally stated objectives are summarized. 8 refs., 2 figs., 1 tab.

52433 (DOE/ER/60617—T1) **Ionization in liquids: Technical progress report, November 1, 1987-October 31, 1988.** Bakale, G. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Radiology). 29 Jul 1988. Contract FG02-88ER60617. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015609/JAW.

Our major research effort in 1987-1988 has been directed toward measurements of the electron attachment rate constants, k/sub e/'s, of chemicals that have been classified as carcinogens or noncarcinogens in long-term animal tests. Also, the author prepared a chapter entitled "Theoretical Implications of the k/sub e/ Test" that will appear in Chemical Carcinogens. As the title indicates, this work provides a theoretical basis for the k/sub e/-carcinogenicity correlation that we have studied for nearly a decade. 78 refs.

52434 (EGG-M—88336) **Replacement of chlorinated hydrocarbons.** Beller, J.M.; Pryfogle, P.A.; Suciu, D.F.; Wikoff, P.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 14p. (CONF-880879—1). NTIS, PC A03/MF A01. Order Number DE88016945/JAW.

From Process technology '88: the key to hazardous waste minimization; Sacramento, CA, USA (15 Aug 1988).

Methods have been identified and tested for systematic evaluations of biodegradable solvents for aircraft parts cleaning, degreasing, and masking-wax removal processes. Screening test have identified solvents that are biodegradable and can efficiently remove masking wax from aircraft parts in a dip tank, and meet the Military Specifications for corrosion. A process data base has been developed to identify all the the processes undertaken at the five Air Force Logistics Commands. To test solvent biodegradability, an ASTM method has been modified consisting of testing a bench scale activated-sludge system and measuring chemical oxygen demand (COD) and adenosine triphosphate (ATP) over a 6-hour period to establish if COD will be reduced to below NPDES limits by the bacteria. Test coupons were coated with masking wax and the cleaning and degreasing efficiency of potential replacement solvents was compared to 1,1,1-trichloroethane and P-D 680 by submerging the coupons in dip tanks for one hour and determining their weight loss. 5 figs.

52435 **(OEFZS—4451) DNA-repair, chromosome alterations and chromatin structure under environmental pollutions.** Altmann, H.; Zasukhina, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie; USSR Academy of Sciences, N.I. Vavilov Institute General Genetics, Moscow (USSR)). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jun 1988. 57p. (BL—729/88; CONF-880754—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704060/JAW.

From International symposium on DNA repair, chromosome alterations and chromatin structure under environmental pollutions; Moscow, USSR (4 Jul 1988).

54 abstracts, 20 of which are within the INIS scope, are presented. The papers are dealing with the influence of some chemicals, environmental pollutants as well as drugs, on the process of DNA repair after ionizing irradiation. Some advanced techniques of detecting genotoxic properties and some papers on the influence of DNA repair on cell differentiation were presented. Genetic changes in man, animals and plants as a consequence of the Chernobylsk accident were described.

52436 **(ORNL/TM—10706) Synthetic and alternate fuels characterization: Final report [August 31, 1988-January 31, 1988].** Griest, W.H.; Guerin, M.R.; Smith, L.H.; Witschi, H.P.; Higgins, C.E.; Tomkins, B.A.; Ho, C.-h.; Ilgner, R.H. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 95p. NTIS, PC A05. Order Number DE88015381/JAW.

Diesel fuels derived from petroleum and synthetic sources were compared chemically and toxicologically to address the issue of whether a changeover of mobility fuels from natural to synthetic sources might be accompanied by greater or different toxicological hazards to military personnel. Diesel fuels derived from petroleum, shale oil, tar sands, and tar sands/petroleum coprocessing were compared for major organic compounds in their polycyclic aromatic hydrocarbon dermal tumorigens, major organic compounds in their inhalable volatiles, mouse dermal tumorigenicity and promoting activity. The database was expanded by a similar comparison of petroleum- and coal-drived fuels for the US Department of Energy (USDOE). The results suggest that highly refined and finished mobility fuels from synthetic or alternate sources will not pose a significantly greater toxicological hazard than current petroleum-based fuels. Toxicological differences are likely to be subtle. 52 refs., 20 figs., 16 tabs.

52437 **(SML—14-1983) Human nuisance and health effects of air pollution in the Sundsvall-Timraa district of Sweden.** Berglund, K. (Statens Miljoemedicinska Laboratorium, Stockholm (Sweden)). 1983. 68p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88754417/JAW.

An investigation was carried out to survey the occurrence of subjectively reported nuisance, symptoms and throat and chest illnesses, possibly caused by the Sundsvall-Timraa environment. The results indicate a major part of the population to be troubled by bad smell, particularly in regions close to pulp and paper mills. In some sites high nuisance frequencies from dust and soot were reported. (G.B.).

52438 **(SNV—3165) Particulate matter in ambient air - Assessment of health risks.** Camner, P. (Karolinska Institutet, Stockholm (SE). Statens miljoemedicinska laboratorium). (National Swedish Environmental Protection Board, Solna). Jul 1986. 41p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754431/JAW.

An investigation, based on literature data and research at SML, was made on deposition of particulate matter in lungs. The importance of mouth and nose breathing respectively is illustrated. By nose breathing only substances <10 micrometers reach the lung as compared to mouth breathing where substances >10 micrometers may deposit in the lung. Swedish limit values of total suspended particulate matter (TSP) of 50 micrograms/cubic meter are recommended as a 6 month mean value and 150 micrograms/cubic meter as a day mean value. For the PM/sub 10/ fraction, which is a measure of the mass fraction of particulate matter in the air that is deposited in the lung by mouth breathing, it is not possible to give a corresponding recommendation. Epidemiological data are lacking and the proposed method of measuring the PM/sub 10/ fraction would underestimate the importance of particles larger than 10 micrometers. (O.S.).

52439 **(SNV—3174) Supervision of air mutagenesis by means of plants.** Ahlfors, A.; Badr, A.; Skaerby, L. (National Swedish Environmental Protection Board, Solna). Jul 1986. 128p. (In Swedish). NTIS (US Sales Only), PC A07. Order Number DE88754432/JAW.

In the Stenungsund area two methods were studied in 1983-85: Tradescantia paludosa-MCN-test and Tradescantia hirsutiflora subacaulis (clone 4430)-stamen hair test. Also a pilot study was done on Arabidopsis thaliana-growing test. Laboratory exposures of both Tradescantia-species were done with specific substances existing in the Stenungsund air environment. (O.S.).

52440 **(SNV—3198) Investigation of mutagenesis of gaseous compounds.** Victorin, K.; Staahlberg, M. (National Swedish Environmental Protection Board, Solna). Jul 1986. 65p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754435/JAW.

At the Stenungsund works various light hydrocarbons are emitted, i.a. the alkenes ethylene, propylene, butadiene and vinyl chloride. Mixing experiments were done in order to find out if mutagenic substances would form when these alkenes are mixed or react with the common reactive, air pollutants, ozone and nitrogen dioxide. Also the individual compounds were tested in the same testing system. The test apparatus comprised a dynamic through flow system permitting studies of individual gases, gas mixtures and interactions with reactants like nitrogen dioxide and ozone and the effect of UV radiation. Salmonella bacteria, primarily, were used as test system (Ames test). In vivo experiments were done in some combinations where mice were exposed and examined with regard to formation of so called micro nuclei in the red marrow corpuscles. By comparative testing of individual gases ethylene oxide turned out to be strongly mutagenic in low concentration, nitrogen dioxide slightly mutagenic but bacteria toxic, and vinyl chloride mutagenic in high concentration. The remaining substances were not significantly mutagenic. The mixing tests showed that mutagenic compounds are formed from propylene, vinyl chloride and butadiene in combination with nitrogen dioxide only by UV radiation. Despite it's chemical reactivity, ozone was considerably less active. A weak mutagenic effect occurred by maximum tolerable ozone concentrations at a high butadiene content but the effect was more pronounced with vinyl chloride and also occurred at lower concentrations. The effect was UV independent. (O.S.).

52441 **(UCRL—21001-88-3) Review of exposure chamber development for use in mature branches of Pinus ponderosa.** Houpis, J.L.J.; Surano, K.A.; Cowles, S. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016178/JAW.

This Progress Report details the performance of the project "Comparison of the Response of Mature Branches and Seedlings of Pinus ponderosa to Ozone" for the months of February to June 1988. During this period, travel to five sites was arranged to investigate chamber and instrument development. These sites were the University of Georgia, Athens, Georgia; the Smithsonian Institution, Rockville, Maryland; Utah State University, Logan, Utah; the Corvallis Environmental Research Laboratory, Corvallis, Oregon; and the Boyce Thompson Institute for Plant Research, Ithaca, New York. An extensive literature review of previous chamber designs was conducted and the initial stages of chamber development and testing have begun. These items are covered in depth in this Progress Report. 18 refs., 2 figs., 5 tabs.

52442 **Site-selective Shpol'skii spectrometry of sulfur-, oxygen-, and nitrogen-containing aromatic compounds in complex samples.** Elsaiid, A.E.; Walker, R.; Weeks, S.; D'Silva, A.P.; Fassel, V.A. (Ames Laboratory-USDOE and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Applied Spectroscopy;* **42**: No. 5, 731-740(Jul 1988).

Laser excited Shpol'skii spectrometry (LESS) was utilized to directly determine nitrogen (N-), oxygen (O-), and sulfur (S-) heterocyclic compounds in solvent refined coal (SRC-II), petroleum crude oil, and carbon black. Characteristic quasilinear LESS excitation and emission spectra of the heterocyclic compounds are presented for the first time under site-selective conditions. Deuterated analogs of dibenzothiophene and dibenzofuran were utilized for quantitation. Site-selective fluorescence spectra of aminopyrene derivatives of polycyclic aromatic compounds (PAC) are also presented for the first time. The potential for utilizing the LESS technique in critical environment and biological studies for the direct determination of N-, O-, and S-heterocyclic compounds and substitutional derivatives of parent PAC has been demonstrated.

52443 **Dioxin from municipal waste incineration.** Travis, C.C.; Hattemer-Frey, H.A. (Oak Ridge National Lab., TN (USA)). pp 99 of 3rd Chemical Congress of North America and 195th ACS national meeting. Washington, DC; American Chemical Society (1988). (CONF-8806119—).

From American Chemical Society Division of Environmental Chemistry meeting; Toronto, Canada (5 Jun 1988).

The authors provide a perspective on municipal waste incineration as a source of human exposure to dioxin by comparing it with background exposure to dioxin by the general population of the US. Results show that the estimated incremental maximum daily intake of facility-emitted dioxins and furans is about 140 times lower than the estimated background daily intake of dioxin.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 51084, 52865

52444 (CONF-760202—, pp 199-202) **Course on non-ionizing radiation protection for state and local public health officers.** Morgan, K.Z. (Georgia Institute of Technology, Atlanta (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A two week course on non-ionizing radiations is being developed for federal, state and local public health officers. There appears to be a great need for such a course in view of the rapidly expanding applications of non-ionizing radiations and the radiation protection responsibilities of public health officers. The radiations covered in this course are ultraviolet, visible, infrared, radio frequency and long wave length as well as mechanical radiation (sonic, infrasonic and ultrasonic), both coherent (lasers) and non coherent radiations are treated.

52445 (CONF-760202—, pp 227-230) **Microwave safety program at NRL.** Booth, L.F. (Naval Research Laboratory, Washington, DC (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The microwave safety program at the Naval Research Laboratory must deal with equipment ranging from search radars to microwave ovens. Problems encountered have centered mainly on the temporary nature of much of this experimental equipment. In order to solve these problems, the safety program requires registration of potentially hazardous equipment and relies basically on field surveys and evaluations to define and control microwave hazards.

52446 (CONF-760202—, pp 239-246) **Aircraft radar in the near field.** Tell, R.A.; Hankin, N.N.; Janes, D.E. Jr. (Environmental Protection Agency, Silver Spring, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

This paper presents an analysis of microwave exposure levels in the vicinity of parked commercial aircraft due to the weather radar installed in the nose of the aircraft. Measurements were made on five aircraft which included three types of aircraft, three types of radar, and four different radar-aircraft combinations. The measured values agree well with values calculated from a model employing near-field gain correction factors. The antennas of aircraft radars normally rotate or scan a specific sector. Measurements were made on stationary antennas and average values of power density were calculated taking into account antenna rotation. With the antennas rotating, only one system produced a level in excess of the current OSHA-ANSI standard of 10 milliwatts per square centimeter (mW/cm^2). For rotating antennas the power density decreased to less than 1 mW/cm^2 at distances greater than 3.5 m (11.5 fr.) for all systems measured.

52447 (CONF-760202—, pp 755-761) **Ultraviolet, visible and infrared radiations in biology and medicine.** McCullough, E.C. (Mayo Clinic/Foundation, Rochester, MN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The increasing frequency in the use of optical (ultraviolet, visible and infrared) radiations in medicine raises the possibility of the involvement of the health physics profession in providing technical services and insuring compliance with the exponential increase in Federal regulations pertaining to non-ionizing radiations. The most frequent uses of optical radiations in medicine are reviewed. Measurement of optical radiations in a clinical environment is discussed.

52448 (RAPRA—88/01/XAB) **Noise in the plastics processing industry: a practical guide to reducing noise arising from existing plant and machinery. Final report.** (Rubber and Plastics Research Association of Great Britain, Shrewsbury). Mar 1985. 59p. NTIS PC$20.00.

It is well established that exposure to excessive noise can cause damage to hearing, induce stress, disturb concentration and reduce working efficiency. Health and Safety Executive inspectors have been instructed to enforce standards to ensure that persons are not exposed to noise greater than 90dB (A) Leg (8 hours). To assist in tackling these problems, the Rubber and Plastics Research Association has published a practical guide to reducing noise arising from existing plant and machinery. The guide was prepared by the Health and Safety Liaison Committee comprising representatives of the British Plastics Federation, Health and Safety Executive and the Trade Unions, under the chairmanship of RAPRA. All commonly-found processes in the industry are covered by the guide. Problem areas are identified and practical advice provided on reducing noise at the source. Case studies, illustrating solutions already achieved, are also included, together with references to sources of information and contacts for advice, and a comprehensive bibliography.

57 Health And Safety

REFER ALSO TO CITATION(S) 52492

58 GEOSCIENCES

REFER ALSO TO CITATION(S) 51010, 52054

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 50800, 52183, 52787

52449 (PER—148, pp 13) **Radiometric dating of a uranium leaching from the Rooiberg felsite.** Farrow, D.; Harmer, R.E.; Twist, D. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.; Pretoria Univ. (South Africa). Dept. of Geology). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

52450 (PER—148, pp 17) **Report on Sm-Nd isotopic studies at MIT.** Hart, R.J. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

5802 Geophysics

REFER ALSO TO CITATION(S) 50573, 50661, 51008, 51216, 51502, 52048, 52052, 52052

52451 (DOE/RL/70039—13) **Earthquake monitoring of eastern Washington [Operation of a Hanford seismic network and related studies]: Final technical report.** (Washington Univ., Seattle (USA). Dept. of Geophysics). Jul 1988. Contract AS06-75RL70039. 51p. NTIS, PC A04/MF A01. Order Number DE88016567/JAW.

This is the final report for the operations and research performed by the University of Washington Geophysics Program on the seismicity and structure of eastern Washington and northeastern Oregon. There have been an average of 64 seismic stations operating between 1975 and 1979 and 105 stations between 1980 and 1988 whose data are telemetered to the University for recording, analysis and interpretation. Since 1976, annual technical reports have been produced that summarize network operation, analysis of data, and research results. The reports include earthquakes that have occurred since 1969. 18 refs., 15 figs., 2 tabs.

52452 (EPRI-NP—5875) **Earthquake ground-motion estimation in eastern North America: Proceedings.** McGuire, R.K.; Schneider, J.F. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA); Risk Engineering, Inc., Golden, CO (USA)). Aug 1988. 480p. (CONF-8703282—). Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016089/JAW.

From Earthquake ground-motion estimation in Eastern North America; Palo Alto, CA, USA (31 Mar 1987).

This report documents original papers presented at a workshop on "Earthquake Ground-Motion Estimation in Eastern North America," held in Palo Alto, California on March 31--April 2, 1987. Papers address issues critical to understanding and estimating strong seismic shaking in eastern North America: the relevance and validity of available earthquake data, estimation of soil effects on the amplitudes and duration of shaking, characterization of the source spectrum, and methods of practical ground motion estimation. A general sense of resolution was achieved during workshop discussions for several important issues, and these issues and resolutions are described in summary papers presented by several authors.

52453 (EPRI-NP—5970) **Reconnaissance investigation of the March 2, 1987, New Zealand earthquake: Final report.** Yanev, P.I.; Vallenas, P.; Williams, D.; Murray, R.C. (Electric Power Research Inst., Palo Alto, CA (USA); EQE, Inc., San Francisco, CA (USA)). Aug 1988. 142p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88016702/JAW.

On March 2, 1987 at 1:43 P.M. a magnitude (M/sub L/)6.3 (M6.3) earthquake struck the Bay of Plenty region of North Island, New Zealand. Propagating along a previously unmapped fault, the earthquake caused surface ruptures near the town of Edgecumbe. The adjacent towns of Kawerau, Te Teko, and Whakatane were also affected. Soil failures, liquefaction, settlement, and landslides occurred throughout the region. A peak horizontal ground acceleration of 0.26g was recorded approximately 6 miles from the fault rupture, and accelerations of 0.30g to 1.0g were estimated in the most severely damaged area. From March 9 to 13 a four member reconnaissance team visited the damaged area to investigate the earthquake's effects on power and industrial facilities. Collected data will be added to the seismic experience data base that is used in analyzing the safety of structures and equipment in nuclear power plants in the United States.

52454 (NUREG/CR—3509) **Power spectral density functions compatible with NRC Regulatory Guide 1.60 response spectra.** Shinozuka, M.; Mochio, T.; Samaras, E.F. (Nuclear Regulatory Commission, Washington, DC (USA); Columbia Univ., New York (USA). Dept. of Civil Engineering and Engineering Mechanics). Jun 1988. 71p. NTIS, PC A04/MF A01 - GPO. Order Number TI88015540/JAW.

Among other possibilities, the Kanai-Tajimi power spectral density enhanced at the higher frequency range is found to be useful for generating ground acceleration time histories that satisfy NRC RG 1.60 requirements. The values of the parameters involved in the spectral density function are recommended for this purpose. Also, a suggestion is made as to how the power spectral density requirements can be placed in combination with those of the current NRC RG 1.60 to ensure both the response and power spectrum requirements.

52455 (PB—88-866827/XAB) **Geophysical tomography. January 1976-July 1988 (Citations from the NTIS data base). Report for January 1976-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Jul 1988. 55p. NTIS PC N01/MF N01.

This bibliography contains citations concerning image reconstruction of geologic properties, internal geometry of rock masses, and mapping of fractures using geophysical tomography. Applications include site characterization, ground-water movement, structural geology, well logging, oil-field recovery processes, underground waste disposal, and geophysical surveys. The citations on techniques include algorithms and software to perform tomographic image reconstruction. (Contains 74 citations fully indexed and including a title list.)

52456 (SV-UG—1987-57) **Tensor VLF measurements in the Siljan area. Gasproject 1987.** Pedersen, L.B.; Zhang, P.; Rasmusson, T.R. (Uppsala Univ. (Sweden). Dept. of Solid Earths Physics). (Swedish State Power Board, Vaellingby). 15 Dec 1987. 97p. NTIS (US Sales Only), PC A05. Order Number DE88754466/JAW.

The research has focused mainly on developing a VLF technique which would enable more information about the bedrock to be obtained than what is currently being obtained using commercial methods. Present VLF measurements make use of only one transmitter and the fracture systems that are detected are biased in the direction of the transmitter. This bias in conventional VLF measurements results in that the fracture systems which are observed are dependent upon the direction of the transmitter and that fractures oriented perpendicular to the transmitter direction are not observed. In the work done in this project use was made of more than one transmitter in order to avoid the biasing problem. In addition, the electric field at each station was also measured giving information about the detailed resistivity of the rock. The work carried out up to now should be regarded as testing of improved VLF acquisition and processing techniques. The results are that if two transmitters are used in the acquisition (preferably 90 degrees apart in azimuth) anf if the 5 components E/sub x/, E/sub y/, H/sub x/, H/sub y/, H/sub z/ are recorded then one can obtain a picture of the surface fracture systems independent of the direction of the transmitters. In special cases, even the dip of these fracture zones can be determined. (authors).

52457 (UCID—21454) **Seismic hazard analysis of Western Venezuela methodology and data collection process.** Savy, J. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 48p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88014697/JAW.

The purpose of this project, initiated by INTEVEP is to develop a seismic hazard characterization for the region of the Lake Maracaibo basin in Western Venezuela (WV) with an emphasis at the sites of dikes built on the eastern side of the lake. One task of the project was to assess the seismicity of this region and to describe it in a form which can be used as input to a seismic hazard analysis. The seismic parameters of interests were seismo-tectonic zonation, distribution of earthquake magnitudes, and the largest earthquake, i.e., upper magnitude cutoff. Because it is difficult, or perhaps impossible, to precisely quantify such seismic parameters

using only the sparse historical record, expert judgment is crucial. Thus two panels of experts were assembled, to supplement the lack of opinions in the possible models of zonation, seismicity, (S-panel) and ground motion attenuation (G-panel). In addition to the ground motion models described in the ground motion questionnaire handed to the G-panel experts, we performed some analysis, at LLNL, to develop a new breed of models where the parameter of interest is now the number of cycles of a given fraction of the peak ground acceleration, as a function of magnitude and distance from the source of an earthquake, rather than the peak ground acceleration (PGA) as a function of magnitude and distance. 20 refs.

52458 (UCRL—53615-86, pp 37-42) **Experimental geophysics.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Experimental Geophysics Group conducts research in rock properties, magma rheology, high-pressure physics using the diamond-anvil cell, and crystal growth. In 1986 the group measured the physical properties of materials ranging from ice to rock to xenon to magma over an extremely wide range of pressures and temperatures. This work, conducted in support of the Laboratory's energy, defense, and research programs, deepened the understanding of the physics of the earth and planets as well as the physics of phase transformations at high pressures. This paper discusses rock properties, crystal growth and electrical conductivity, high pressure studies, ice mechanics, stress gauge development effect of nonhydrostatic stress on chemical potential, and magma rheology. A list of recent publications is given. 29 references.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 50343, 50538, 50559

52459 (MMIJ—8801, pp 365-366) **Sleeve fracturing and rock pressure (part 3).** Araki, Hideo; Hiratsuka, Takaaki; Sugawara, Katsuhiko; Ishimura, Yutaka. (Kumamoto Univ., Faculty of Engineering, Kumamoto, Japan; Electric Power Development Co., Ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In Proceedings of 1988 Spring Symposium of The Mining and Mtallurgical Inst. of Japan.

Analysis was made of the sleeve fracturing which occurs when an internal pressure was applied to a bore hole through a cylindrical sleeve, and the result of the study on the method to determine the state of the initial stress by the stress dependency is reported. Figures are given for the relationship between the internal pressure and the change in the diameter which were obtained by the test of the original position in granite. Figures are presented also for the relation of the internal pressure and the lengths of cracks. As a means to determine the initial stress of a base rock by sleeve fracturing, a method is proposed for the simultaneous evaluation of initial stress and the stress extension coefficient at the head of the crack during crack development process, employing such measurement values as the pressure at the end of the crack opening measured by multi-stage-load multi-channel bore hole changes, pressure at the time of resumption of development, and the rate of bore hole changes in the range. An explanation is made on the related observation equations. (4 figs, 1 tab)

52460 (MMIJ—8801, pp 367-368) **Sleeve fracturing and rock pressure (part 4).** Shiraishi, Hironobu; Ohara, Yuzo; Sugawara, Katsuhiko; Ishimura, Yutaka. (Kumamoto Univ., Faculty of Engineering, Kumamoto, Japan; Electric Power Development Co., Ltd., Tokyo, Japan). Apr 1988. (In Japanese). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88754547/JAW.

In proceedings of 1988 Spring Symposium of The Mining and Metallurgical Inst. of Japan.

To analyze the developing process of tensile cracks which occur when internal pressire is applied to a bore hole, the stress extension coefficiency of cracks on the bore hole surface was analyzed by DDM. Samples of rectangular shaped deformation discontinuous elements arranged on the cylindrical wall and cracks are illustrated, and the opening state of cracks when the internal pressure is applied is shown as the example of the analysis. The result of the analysis shows similar distribution to that of $H(a/r) = K_1/(\pi a)/sup1/2/$ in the case of two demention, and the analyzed value coincided with the distribution of $\cos^2 d$. The stress extension coefficient was analyzwd on the assumption that the surface of the bore hole was semielliptical, and the effect of the length and inclination of cracks under internal pressure were clarified. (5 figs, 5 refs)

52461 (PER—148, pp 20-26) **Host minerals for uranium and thorium in the Cape granite.** Schoch, A.E. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Geology). Nov 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704062/JAW. (CONF-8611268—).

From Discussion forum for researchers in nuclear geology; Broederstroom, South Africa (26 Nov 1986).

The uranium and thorium in Cape granite reside chiefly in trace minerals. The principal host minerals differ much from pluton to pluton. The large composite Khubus pluton in the Richterveld is composed of a central body of syenite surrounded by various types of granite. The granites are usually very low in dark minerals. According to autoradiographic results, the bulk of the uranium and thorium in the Khubus pluton is situated in the zircon, rather than in the sphene, apatite and fluorite. In many intrusives of the Cape granite suite most of the uranium is situated in a single host mineral such a zircon, xenotime, sphene or even uraninte. The most important thorium host mineral is monazite. The radio-element host mineral spectrum is unique for each different intrusive.

5804 Geochemistry

REFER ALSO TO CITATION(S) 50661

52462 (UCRL—53615-86, pp 9-12) **Geochemistry.** Jul 1987. NTIS, PC A04/MF A01. Order Number DE88000821/JAW.

In Earth sciences annual report, 1986.

The Geochemistry Group comprises geochemists, petrologists, and physical chemists working on a variety of earth science projects. The geochemists and physical chemists work primarily in low-temperature geochemistry performing experiments to determine the solubility and dissolution kinetics of minerals; study waste-form/rock/water interactions as a function of temperature and pressure; and develop and apply equilibrium thermodynamic/kinetic reaction-path geochemical modeling (EQ3/6). They also make measurements of the chemical properties of aqueous electrolytes (density, activity, and diffusion coefficients) and study the distribution and chemical reactivity of dissolved inorganic species in surficial and ground waters. The petrologist are developing microanalytic techniques - primarily infrared - to study the composition of fluid inclusions. In addition, they are studying the isotope systematics and determining the ages of various rocks, examining crustal metasomatism, and conducting material characterization studies of a variety of solids. 1986 accomplishments are summarized and recent publications are listed. 36 references.

52463 **Pt-group metal anomalies in the Lower Mississippian of southern Oklahoma.** Orth, C.J.; Quintana, L.R.; Gilmore, J.S.; Barrick, J.E.; Haywa, J.N.; Spesshardt, S.A. (Los Alamos National Lab., NM (USA)). *Geology;* **16**: No. 7, 627-630(Jul 1988).

Four iridium (Pt-group elements) abundance anomalies have been found within a stratigraphic span of 3 m in the Lower Mississippian of Oklahoma. In ascending order, the first anomalies occur at the top of the Woodford Shale: Ir = 0.25 ppb, Pt = 48 ppb, Os = 7.5 ppb, and Au = 18 ppb. The anomalies occur just below a redox boundary and the authors suspect that the enriched elements were precipitated from sea water that contacted the organic- and sulfide-rick black shale. Two more anomalies occur in the Welden Limestone, the lower one weak and the upper one strong (Ir = 0.42 ppb, Pt = 50 ppb, Os = 0.075 ppb, and Au = 0.14 ppb). The excess Ir and Pt (also Co, As, and Ni) might have been enriched from sea water by bacteria at these two horizons. A 70-cm-thick interval of excess heavy siderophiles occurs in the overlying Caney Shale; the interval contains the following peak concentrations: Ir =

0.56 ppb, Pt = 150 ppb, Os = 0.51 ppb, Co = 725 ppm, and Ni = 1450 ppm. These elements vary in proportion to the Al (clay) content and the authors suspect that they were carried in with detrital material from erosion of ultramafic source rocks. The authors found no evidence of microspherules or shocked-mineral grains in any of these anomaly zones.

5805 Oceanography

REFER ALSO TO CITATION(S) 50800, 50937, 52787

52464 **(CRIE-U—87060) New type concrete block 'SEASUP' for mild slope seawalls.** Hasegawa, Hiroshi; Kashima, Ryoichi. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Dec 1987. 36p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88754537/JAW.

The study deals with the mild slope sea protecting system which is advantageous in protection of shores, keeping of coastal views, beach utilization, and permeation of sea water. Such a basic beach protection profile as is effective in creating the foreshore was selected by mobile bed model experiment utilizing sea-water permeable plates. Based on the results, a new type concrete block 'SEASUP block' of mild slope seawalls and its construction method were developed. In order to grasp the hydraulic characteristics of the SEASUP seawalls on beach protection, the mobile bed experiment of the seawalls with a scale of 1/25 was conducted. As a result, it was found that, for the sea wave conditions under which natural seashores are eroded, the installation of the AEASUP seawalls (normal gradient of 1/3, void ratio of 20%) on a shore line enables the shore to be changed to an accretive shore. (20 figs, 6 tabs, 12 refs)

52465 **(DOE/ER/60285—5) Simulation analysis of moored fluorometer time series from the Mid-Atlantic Bight: Progress report for FY 1987-88.** Walsh, J.J. (University of South Florida, St. Petersburg (USA). Dept. of Marine Science). 1988. Contract FG05-85ER60285. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012907/JAW.

The SEEP-I study of the Mid-Atlantic Bight (MAB) was completed and results will be published this summer in a special issue of Continental Shelf Research for which the principal investigator was guest editor and author of three manuscripts. Additional results of the work in the South Atlantic Bight (SAB) are discussed in a recent text published by Academic Press. To summarize the field component of the MAB study, i.e., the analysis of moored fluorometer records, the researchers found a significant export of chlorophyll from the shelf to the slope $\simeq 0.30$ g C m^{-2} day^{-1} during February to April 1984. Vertical fluxes at the shelf break were 0.10-0.16 g C m^{-2} day^{-1}, suggesting that most of the organic matter in the deep slope waters originates from shelf-produced phytoplankton that is laterally injected near the bottom, rather than from sinking, slope-produced phytoplankton. Thus the shelf may be a significant source of deep slope organic matter in the Mid-Atlantic Bight. 7 refs., 1 fig.

52466 **(DOE/ER/60376—3) Shelf export of particulates/transport in continental margin water: Progress report for the period September 1987--September 1988.** Pietrafesa, L.J. (North Carolina State Univ., Raleigh (USA)). 1988. Contract FG09-85ER60376. 86p. NTIS, PC A05. Order Number DE88016143/JAW.

The physical oceanographic objectives of SEEP are to identify possible pathways of exchange of particulate matter between the shelf and continental slope as these processes relate to the biological objectives of the determination of the processes governing the production and fate of biogenic particles and the chemical objectives of partitioning the natural and containment chemical species between dissolved and particulate phases. During the present funding period, research activities have been directed towards: publishing the results of SEEP-I; publishing further results from NCSU's South Atlantic Bight studies; designing and constructing four cages which will house the RD-Acoustic Doppler Current Profilers including one to be used in SEEP-II; determining the temporal and spatial scales of physical processes observed during Phase I of SEEP-II in preparation for finalizing the mooring positions and sampling intervals for SEEP-II.

64 PHYSICS I

REFER ALSO TO CITATION(S) 51380, 52609, 52610

52467 **(INIS-SU—37/A) General and nuclear physics. Scientific-technical collection.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 97p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Individual papers in scope for the data base are processed separately. (DLC)

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 52590, 52591, 52594, 52819

52468 **(AD-A—194100/4/XAB) Study of mechanisms producing astrophysical jets. Final report, 9 July 1987-16 March 1988.** Turner, K.C. (Innovative Systems, Ramey (Puerto Rico)). Mar 1988. 35p. (IS—0001F). NTIS, PC A03/MF A01.

During this study, Innovative Systems reviewed the current situation regarding astrophysical jets, with emphasis on their acceleration process. Jets on both galactic and stellar scales are contrasted, and a common geometrical model for these phenomena is presented. After the presentation of a number of currently puzzling problems, a two-year research program is outlined, whose aim is to further understand the acceleration of material to relativistic velocities in nature on various scales.

52469 **(DOE/ER/13670—T1) Evidence for temporal variation in the acoustic and f-mode eigenfrequency spectrum of the Sun.** Oglesby, P.H.; Hill, H.A.; Rabaey, G.F. (Arizona Univ., Tucson (USA). Dept. of Physics). 1988. Contract FG02-87ER13670. 10p. (CONF-880780—4). NTIS, PC A03/MF A01. Order Number DE88015650/JAW.

From 27. plenary meeting of COSPAR; Espoo, Finland (18 Jul 1988).

The power spectrum obtained from 1985 solar radiation intensity measurements was tested for evidence of frequency shifts of the low-order, low-degree acoustic modes and intermediate degree f-modes classified at SCLERA (Santa Catalina Laboratory for Experimental Relativity by Astrometry). These classifications were based on 1979 differential radius observations. Maxima in the coincidence rates between the peaks in the 1985 power spectrum and the classified frequency spectrum were found for frequency shifts (of the order of 0.05μHz) that are dependent on degree. These shifts indicate a change in eigenfrequency spectrum over a 6 year period. The coincidence rates between the peaks in the 1985 power spectrum and the classified frequency spectrum for multiplets taken in subgroups of $\sim$5 (same n and contiguous in {ell}) were typically 3 to 5 σ above the accidental coincidence rate. Since these modes primarily reside in the convection zone, details of temporal changes of these eigenfrequencies should yield interesting information about the level of variations in the properties of the convection zone over, for example, the solar cycle. 13 refs., 1 fig., 2 tabs.

52470 **(DOE/ER/13670—T2) Tests for the properties of solar gravity mode signals in total irradiance observations.** Kroll, R.J.; Hill, H.A.; Jian, Chen. (Arizona Univ., Tucson (USA). Dept. of Physics). 1988. Contract FG02-87ER13670. 11p. (CONF-880780—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015651/JAW.

From 27. plenary meeting of COSPAR; Espoo, Finland (18 Jul 1988).

It has been found that a significant fraction of the gravity mode power density in the total irradiance observations appears in

sidebands of classified eigenfrequencies. These sidebands are interpreted as harmonics of the rotational frequencies of the solar surface. The power density distributions in the sidebands are consistent with the observed differential rotation of the photosphere and the degree classifications of the respective gravity modes. These findings give further evidence that gravity mode signals are present in the total irradiance observations as well as give an independent check on the gravity mode detections and the {ell} classifications. The small fraction of the power density remaining at the eigenfrequency of the gravity mode can account for the difficulty that has been experienced in detecting gravity mode signals in total irradiance observations. 14 refs., 4 tabs.

52471 (INIS-SU—51, pp 42-44) **Polarization properties of electromagnetic radiation during quantum evaporation of a rotating black hole.** Bolashenko, P.A.; Frolov, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

The correlation matrix for electromagnetic radiation appearing during quantum evaporation of black holes is calculated. The polarization effects described by it are studied in extreme cases of slowly and quickly rotating black hole. 11 refs.

52472 (INIS-SU—51) **Quantum radiophysics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1987. 50p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Papers in this collection were abstracted separately.

52473 (KEK—87-19, pp 111-123) **Antiproton and antimatter. A balloon experiment with the model solenoid.** Orito, S. (Tokyo Univ. (Japan)). Oct 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

We propose an balloon experiment which utilizes the model thin solenoid. The detector has a large solid angle of 0.5 m/sup 2/ Sr. Assuming a 10 day's flight around the south pole, the antiheliums can be searched down to a level of 10/sup -8/ relative to the helium. Antiproton spectrum will be accurately measured above 0.2 GeV based on 5 x 10/sup 5/ antiprotons. A very sensitive search of GeV γ rays from point-like sources such as supernova 1987a or Vela x-1 can also be performed at the same time.

52474 (KEK—87-19, pp 124-129) **Elemental composition of cosmic ray.** Yanagida, Shohei. (Ibaraki Univ., Mito (Japan). Faculty of Science). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

The report first summarizes some data that have been obtained so far from observation of isotopes and elements in cosmic rays in the low energy region. Then, objectives of studies planned to be carried out with Astromag are outlined and the number of incident particles expected to be measured by baloon observation is estimated. Heavy elements with atomic numbers of greater than 30 are considered to be formed through neutron absorption reactions by the s- or r-process. Observations show that products of the r-process is abundant in cosmic ray sources. The escape length depends on energy. In relation to this, it has been reported that the ratios Ar-Fe and Ca-Fe increase above 200 GeV-n while such a tendency is not observed for K, Sc, Ti or V. Thus, no satisfactory models are available at present which can fully explain the changes in the escape length. The ratio /sup 3/He-/sup 4/He in the range of 5 - 10 GeV-n is inconsistent with the general theory that interprets the escape length of heavy elements. Some models, including the supermetallicity model and Wolf Rayet theory, have been proposed to explain unusual ratios of isotopes in cosmic rays, but more measurements are required to verify them. It is expected that Astromag can serve to make observations that can clarify these points. (Nogami, K.).

52475 (KEK—87-19, pp 130-136) **Measurement of heavy particle and isotope.** Matsuoka, Masaru; Kohno, Takeshi; Imai, Takashi; Munakata, Kazuoki. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

The report describes some achievements made so far in developing heavy particle and isotope measuring equipment that is planned to be mounted on the No.6 technical test satelite of the National Space Development Agency, ETS VI. Some ideas are proposed for such heavy particle and isotope measuring equipment that uses Astromag. The structure of SSD is shown which is planned to be incorporated in the sensor for the equipment. The planned charged particle detector consists of position sensitive detectors, PIN diodes and Si(Li) plates. Tests are made for the basic characteristics of such a detector. The characteristics of a PSD are also investigated. The PSD has a resolution of about 1 mm for 14 MeV He. Tests of a 0.3 mm PIN diode and 1.2 mm Si(Li) is carried out with 234 MeV-nucl Fe beams to determine their pulse height distribution. The PIN diode and Si(Li) are found to have a resolution of 6.79 and 17.6 MeV for energy loss of 158 and 710 MeV, respectively. If developed, a stripe-type Si PIN diode will serve for analysis of isotopes. A conceptual diagram of such a stripe device is proposed. The mechanism of measurement by a heavy particle and isotope detecting system incorporating Astromag is also illustrated. (Nogami, K.).

52476 (KEK—87-19, pp 137-144) **Measurement of gamma-rays above 1 GeV by ASTROMAG.** Nakamura, Kenzo. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Oct 1987. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780144/JAW. (CONF-8707191—).

From ASTROMAG workshop; Oho, Japan (9 Jul 1987).

The present study examines the feasibility of the application of a matter-antimatter spectrometer incorporating Astromag to measurement of gamma-rays. In the spectrometer under consideration, gamma-rays are converted to electron-positron pairs by an electromagnet and cryostat and the momentum vectors of these electrons and positrons are measures separately to determine the direction of the original gamma-rays. It is suggested that an about one-year observation with an Astromag R-D magnet performed on a space station will provide data of statistic significance on the isotropic and galastic components of diffuse gamma-rays up to several 10s GeV and 100 GeV, respectively. For gamma-rays from a point source, the magnet will have a sensitivity up to an integral flux of 7 x 10/sup -9/ photons-cm/sup 2/ for gamma-rays above 1 GeV. It is expected, however, that GRO-EGRET has a higher potential for measurement up to about 30 GeV. The high resolution performance of Astromag is particularly advantageous in measuring monochromatic gamma rays in the GeV range. If they come from $\gamma\gamma$ pair annihilation, however, it seems difficult for an R-D magnet to provide data of statistic significance even when γ is the major component of the dark matter. (Nogami, K.).

52477 (UCRL—53865) **Unstable radiative-dynamical interactions.** Ghan, S.J. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88016183/JAW.

The interaction between trace shortwave radiative absorbers and the dynamical circulation is shown to be linearly unstable for horizontally uniform basic states with a vertical gradient in the basic state absorber mixing ratio. Two types of instability are identified, described as the advective mode and the propagating mode. The advective mode is usually unstable when the basic state absorber mixing ratio decreases with height. Upward motion, high absorber concentration and arm temperatures are typically in phase for this mode. Growth rates, which can be competitive with those associated with baroclinic instability, are largest for perturbations that are much shorter than the internal deformation radius. Thus, the requirement that the basic state be horizontally uniform is often satisfied for the advective mode. The propagating mode is normally unstable when the basic state absorber mixing ratio increases with altitude. Propagating waves such as Rossby and inertia-gravity waves

are amplified by the feedback with absorber transport and radiative heating. Growth rates for the propagating mode are usually bounded by the frequency of oscillation of the ambient wave, an important limitation for slowly propagating waves such as Rossby waves. Vertical transport of the absorber by the amplifying mode is down the basic state absorber gradient in each case. Complicating factors such as the effects of dissipative processes, vertical shear, and scattering of sunlight are also considered. 40 refs., 42 figs., 6 tabs.

52478 **(UCRL—97451) Synthesis of accretion disk and nonthermal source models for AGN.** Band, D.L.; Malkan, M.A. (Lawrence Livermore National Lab., CA (USA)). 25 May 1988. Contract AC04-76DP00789. 4p. (CONF-8710344—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013098/JAW.

From Georgia State University conference on active galactic nuclei; Atlanta, GA, USA (28 Oct 1987).

A scenario for the central engine of AGN has been developed consisting of a massive black hole (MBH) onto which gas accretes through an accretion disk. The accretion disk radiates the observed optical and ultraviolet continua. Surrounding the MBH is a nonthermal source which produces the infrared and soft x-ray continua by synchrotron emission, and the x-ray spectrum by inverse Compton scattering of the optical-ultraviolet photons from the accretion disk. Previously we modeled the accretion disk (M.A.M.) and nonthermal source (D.L.B.) separately, and here we combine the two models to form a unified description of the AGN engine. This combined model can be inverted to determine source parameters from observed spectra. A group of AGN for which multiband observations exist can then be modeled to: demonstrate the validity of the combined model for a large number of objects; establish the range of parameter values that describe the source; and search for any correlations between source description and type.

52479 **Dynamical cosmic strings from a gauge theory of gravity.** Furlong, R.C. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 6, 1701-1705(15 Sep 1988).

A new dynamical realization of O(5) gauge Euclidean gravity is proposed and shown to possess topologically nontrivial features, cosmic-string flux tubes and dark-matter solitons, of a purely gravitational origin (no Higgs particle needed).

52480 **Quantum probability distributions in the early Universe. III. A geometric representation of stochastic systems.** Graziani, F.R. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 6, 1802-1808(15 Sep 1988).

We present a geometric interpretation of the dynamics of quantum stochastic systems obeying the Wigner equation. We apply this representation to the quantum fluctuations of the homogeneous long-range free scalar field in de Sitter space ($m<<H$). This geometric picture leads to the concept of trajectories in moment [i.e., $<phi(t)>$, $<phi^2(t)>$, $<phi^3(t)>$, ...] space. Up to initial conditions, each trajectory uniquely characterizes the evolution of the system. The stationary states of the system act like fixed points or attractors in the moment space. We present the evolution of the scalar field as a flow in the moment space and show that the Bunch-Davies vacuum is the fixed point.

52481 **Forward-reverse shock pairs associated with transient disturbances in the solar wind at 1 AU.** Gosling, J.T.; Game, S.J.; Smith, E.J.; Burton, M.E. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A8, 8741-8748(1 Aug 1988).

While relatively common in the outer heliosphere, forward-reverse shock pairs occur rarely in the solar wind at 1 AU. Using the combined solar wind plasma and magnetic field data from ISEE 3 for the interval from August 1978 through February 1980 we have identified several examples of such shock pairs at 1 AU. Two of these shock pair events were clearly associated with transient disturbances rather than with corotating streams. Strong bidirectional electron heat flux events, which we identify as the coronal mass ejecta (CME) driving the shocks, were detected during both of these disturbances. In the stronger of the two disturbances the reverse shock was found within the CME and was separated from the forward shock by ~0.2 AU; the pressure was nearly constant between the two shocks. On the other hand, in the weaker of the two disturbances the reverse shock had propagated entirely through the CME and trailed the forward shock by ~0.3—0.4 AU; the pressure declined substantially and monotonically between the two shocks. The overall disturbance profiles for these two events compare favorably with the results of previously published numerical simulations. On the basis of those simulations we suggest that these two events are prototypes of "driven" and "blast" distrubances, wherein the time scale of the initial velocity perturbation near the Sun is, or is not, short compared to the transit time to 1 AU. Our observations support the notion that reverse shocks in disturbances are most likely to be found near the central axes of such disturbances. copyright American Geophysical Union 1988

6402 Atmospheric Physics

52482 **(AD-A—193858/8/XAB) Investigation of the sun-aligned F-aligned F-region walls and related phenomena in the auroral latitude range. Final report, 1 March 1986-28 February 1987.** Steen, A. (Kiruna Geofysiska Inst. (Sweden). Dept. of Space Physics). 21 Jul 1987. 61p. NTIS, PC A04/MF A01.

This final scientific report describes the research activities in Kiruna utilizing ground-based optical equipment, incoherent scatter radar, and VIKING and HILAT satellites for the study of auroral processes. The development work of the optical instrumentation is summarized, and the current scientific work is reviewed.

52483 **(INIS-SU—51, pp 25-27) On cross section growth with energy rise of hadron interaction with air atomic nuclei on a basis of height dependence of extensive air showers at energies above 10/sup 15/eV.** Barkalov, K.V.; Dubovyj, A.G.; Dyatlov, P.A.; Nesterova, N.M.; Stavrev, P.V. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

The data on the absorption of the electron component of extensive air showers in the atmosphere obtained at a modernized Tien Shan device prove a lower cross section value in the 1-20 PeV energy range than in the case of extrapolation of accelerator data on pp interaction and recalculation to the interaction with nuclei. 11 refs.; 2 figs.

52484 **(OUP—88-09) Structure and dynamics in the polar cleft: coordinated satellite and ground-based observations in the prenoon sector.** Sandholt, P.E.; Jacobsen, B.; Lybekk, B.; Egeland, A.; Meng, C.I.; Newell, P.T.; Rich, F.J.; Weber, E.J. (Oslo Univ. (Norway). Fysisk Inst.; Johns Hopkins Univ., Baltimore, MD (USA); Air Force Cambridge Research Labs., Bedford, MA (USA). Geophysics Research Directorate). (Oslo Univ. (Norway). Fysisk Inst.). May 1988. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754485/JAW.

Observations of electron and proton precipitation fluxes and Birkeland currents from spacekraft DMSP F7 and simultaneous ground-based optical measurements from Svalbard ({similar←to}75 deg geom.lat.) of dayside aurorae ({similar←to} 09 MLT) are presented. In these cases, the auroral emissions within the field of view can be separated in different latitudinal zones with corresponding structures in the particle precipitation. The temporal evolution of these structures is monitored by the ground-based instruments, indicating the presence of both stationary cleft emissions produced by soft electron fluxes (energy a few hundred eV) and multiple, transient, discrete arcs and arc-fragments corresponding to the precipitation of keV electrons. The latter are associated with narrow sheets of upward flowing Birkeland currents and reduced proton precipitation, suggesting the presence of field-aligned potential drops above the spacecraft. Assuming that these low-altitude structures map to the low-latitude boundary layer of the magnetosphere,

they correspond to a strong filamentation of the boundary layer, in the prenoon sector.

52485 (OUP—88-11) Midday auroral breakup. Sandholt, P.E.; Lybekk, B.; Egeland, A.; Nakamura, R.; Oguti, T. (Oslo Univ. (Norway). Fysisk Inst.; Tokyo Univ. (Japan)). (Oslo Univ. (Norway). Fysisk Inst.). Aug 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754752/JAW.

Groundbased observations of the midday aurora by all-sky TV and meridian scanning photometers reveal the intermittent occurence of discrete auroral displays within the cusp/cleft. A typical sequence includes the following features: Auroral brightening, near the equatorward boundary of the persistent cusp/cleft arc and subsequent poleward motion of discrete forms through the cusp/cleft region. A strong westward component of auroral motion, both of the individual forms and internal ray structures within these forms, if often observed. At maximum brighness green line intensities of {similar←to} 10 kR are observed, even within the interval characterized as the midday gap. The duration of the whole sequence is normally less than 10 minutes. During this period the auroral activity moves poleward, in some cases by 3-5 degrees, say from 71/sup o/ up to 75/sup o/ MLAT. Characteristic ground magnetic signatures are observed, including a {similar←to} 50 - 100 nT positive deflection in the H-component and a negative Z-component at stations located poleward of the initial brightening. A poleward propagating filamentary Hall current belt associated with the discrete aurora is inferred from the optical and magnetic data. A quantitative estimate shows that the conductivity enhancement, due to electron precipitation in conjunction with northward electric field, roughly accounts for the magnetic deflection on the ground. Series of such events are often observed when the cusp is loacted at rather low latitudes, say south of 75/sup o/ MLAT, presumably associated with negative IMF B z. 23 refs.

52486 (PB—88-213665/XAB) First CEDAR data base report. Technical note. Sica, R.J.; Richmond, A.D.; Emery, B.A.; Chakrabarti, S.; Wickwar, V.B. (National Center for Atmospheric Research, Boulder, CO (USA)). Feb 1988. 68p. (NCAR/TN—308-STR). NTIS, PC A04/MF A01.

The Coupling, Energetics, and Dynamics of Atmospheric Regions (CEDAR) program is an international, cooperative effort within the aeronomy community to further our understanding of Earth's upper atmosphere. The program will be highlighted by numerous multi-instrument measurement campaigns and global simulations of the magnetosphere-ionosphere-atmosphere system. To achieve the full scientific benefits of these observations and simulations will require the ability to access large amounts of data from many different instruments and models. The report describes a recommended data-base system for the CEDAR program to help establish this access.

52487 Nature and the nonlinear evolution of electrostatic waves associated with the AMPTE solar wind releases. Omidi, N.; Akimoto, K.; Gurnett, D.A.; Anderson, R.R. (Institute of Geophysics and Planetary Physics, University of California, Los Angeles). *Journal of Geophysical Research;* **93**: No. A8, 8532-8544(1 Aug 1988).

To understand the generation and the nonlinear evolution of the electrostatic waves observed during the AMPTE (Active Magnetosphere Particle Tracer Explorers) solar wind releases, a detailed investigation is conducted. Previous linear studies have indicated that two distinct sets of instabilities may be responsible for the generation of these waves. One set consists of ion acoustic type instabilities which are insensitive to the presence of a background magnetic field, while the other group corresponds to the modified two-stream instabilities and requires the solar wind flow to be across the ambient magnetic field. In order to establish which set of instabilities are more viable for the generation of the observed electrostatic waves a detailed linar Vlasov theory has been conducted by numerically solving the full electromagnetic dispersion relation. In addition, both the plasma wave and the magnetic field measurements by the IRM (Ion Release Module) spacecraft were used to correlate the frequency and the power of the observed waves with the magnitude and the direction of the solar wind magnetic field. The results of these analyses indicate that the ion acoustic type instabilities have growth rates that are an order of magnitude or more larger than those of the modified two-stream instabilities. Similarly, the observations show no correlation between the magnitude and the direction of the ambient magnetic field on the one hand and the wave frequency and amplitude on the other hand, thus indicating that the ion acoustic type instabilities are the likely generation mechanism. In order to investigate the nonlinear evolution of these instabilities and discern their role in the coupling of the released ions to the solar wind, one-dimensional full particle as well as fluid electron electrostatic simulations have been performed.

52488 ISEE 1 and 2 observations of ion distributions at the plasma sheet: tail lobe boundary. Takahashi, K.; Hones E.W. Jr. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A8, 8558-8582(1 Aug 1988).

Observations of plasma ions (0.075—29 keV) at or near the plasma sheet: tail lobe boundary made with the ISSE 1 and 2 spacecraft are the principal topic of this paper. We describe crossings of this boundary that occurred during various levels of geomagnetic activity at distances X/sub SM/ = -7 to -13 R/sub E/, near local midnight, and 2 R/sub E/ or more above the estimated location of the tail current sheet. Fluxes of ions directed along the magnetic field lines (referred to as ion beams) with kinetic energies of 1->29 keV are commonly observed during crossings of this boundary. The ion beams nearest the edge of the plasma sheet are directed earthward, while deeper within the plasma sheet, additional ion beams, directed tailward, are encountered, usually resulting in bidirectional or counterstreaming ion distributions. The ion distribution functions for these clearly indicate that the tailward directed beams are reflected versions of the earthward directed beams, returning after mirroring in the stronger magnetic field near the Earth.

52489 Cross-B convection of artificially created, negative-ion clouds and plasma depressions: Low-speed flow. Bernhardt, P.A. (Earth and Space Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A8, 8696-8704(1 Aug 1988).

A negative-ion, positive-ion plasma produced by the release of an electron attachment chemical into the F region becomes electrically polarized by the collisions with neutrals moving across magnetic field lines. The resulting electric field causes E x B drift of the two ion species and the residual electrons. The cross-field flow of the modified ionosphere is computed using a two-dimensional numerical simulation which includes electron attachment and mutual neutralization chemistry, self-consistent electric fields, and three-species plasma transport. The velocity of the plasma is initially in the direction of the neutral wind because the negative-ion cloud is a Pedersen conductivity enhancement. As the positive and negative ions react, the Pedersen conductivity becomes depressed below the ambient value and the velocity of the plasma reverses direction. A plasma hole remains after the positive and negative ions have mutually neutralized. The E x B gradient drift instability produces irregularities on the upwind edge of the hole. These processes may be observed experimentally with optical and backscatter-radar diagnostics.

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REFER ALSO TO CITATION(S) 51820, 52033, 52153, 52615

52490 (BNL—41511) Muonic molecular formation under laser irradiation and in the clustered ion molecule (The effect of protonium additive on the muon catalyzed fusion cycle). Takahashi, Hiroshi. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 14p. (CONF-8805170—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015858/JAW.

From Muon catalyzed fusion workshop; Sanibel Island, FL, USA (2 May 1988).

The formation rate of the dtμ molecule is very sensitive to the differences in the vibrational rotational level between D_2 and [(dtμ)-d-2e}] molecules. The density effect of the normalized reaction rate has been studied by the resonance broadening due to colli-

sional quenching. The surrounding molecules of the molecule forming dt{mu} act as the third body which takes out the excess energy forming dt{mu} from t{mu}, and the formation reaction occurs with the excitation of the vibrational state just below the threahold energy. By using the laser as the third body, the rate of resonance formation can be increased. In my last paper, the formation rate was calculated under high-intensity laser irradiation, using Vinitsky's model assuming that the laser interacts directly with the deuteron and modulates the interaction between t{mu} and d{sub 2} nuclei. However, the laser interacts more strongly with the electrons, because the interaction energy of the laser and the charged particle is proportional to the velocity of the particle's motion, and the velocity of the electron is a few thousand times greater than the velocity of the nuclei. This interaction with electrons was neglected in my last paper. In the present paper, the enhancement of the dt{mu} formation rates by the strong laser irradiation is studied, taking into account the laser electron interaction; It was shown that the enhancement can be achieved by an intensity lower than the one described previously. 29 refs., 5 figs., 3 tabs.

52491 **(BONN-HE—88-07) Avoided level crossings and pair production in strong Coulomb fields.** Dietz, K.; Roemer, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Freiburg Univ. (Germany, F.R.). Fakultaet fuer Physik). (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Freiburg Univ. (Germany, F.R.). Fakultaet fuer Physik). Mar 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754307/JAW.

Generalising previous work on static strong Coulomb fields to the time-dependent case we propose an alternative e/sup +/e/ sup -/-pair production mechanism relying on avoided crossing transitions between positive and negative energy states. The resulting essential independence on the details of the collision process nicely matches experimental findings.

52492 **(CONF-880948—2) Production of S_2F_{10} by SF_6 spark discharges.** Sauers, I.; Votaw, P.C.; Griffin, G.D. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015298/JAW.

From 9. international conference on gas discharges and their applications; Venice, Italy (19 Sep 1988).

The highly toxic compound S_2F_{10} is formed in SF_6 following spark discharges. When the spark cell is dried, the S_2F_{10} yield was 6.8 {times} 10/sup {minus}11/ mol/J at an SF_6 pressure P = 133 kPa. Moisture appears to suppress the S_2F_{10} yield, although once formed, the S_2F_{10} is quite stable with respect to moisture. This could explain the variation in observation from experiment to experiment in the literature. These results also raise important questions as to the influence of drying agents that are used in high-voltage systems on the S_2F_{10} yield. 13 refs., 2 figs., 1 tab.

52493 **(CONF-880948—3) Ion chemistry in SF_6 corona.** Sauers, I. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015297/JAW.

From 9. international conference on gas discharges and their applications; Venice, Italy (19 Sep 1988).

Although SF_6^- is known to be the major negative charge carrier initially produced by electron attachment, the subsequent ion chemistry of SF_6 corona is not completely established. Recent efforts to model the yield of the neutral by-product SOF_4 in SF_6 corona suggest that reactions of SF_6^- with SOF_4 can be an important factor on the model. Reactions of SF_6^-, with various species that are either present initially in the gas or are produced by the corona and allowed to accumulate, result in the formation of stable product ions. To this end, negative ions produced by corona discharges in SF_6 have been studied by mass spectrometry in the pressure range 1.6-20 kPa (12-150 torr). 9 refs., 5 figs., 2 tabs.

52494 **(CRN-VIV—46) Non-linear beam optical calculations and measurements for a sputter negative ion source.** Chao, S.X.; Heng, G.; Rebmeister, R. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Dec 1987. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754950/JAW.

This paper describes a simple and rapid method for calculating the non-linear optical properties of a negative ion beam from a sputter-type source model 860. The calculation includes the space charge effects and non-linear aberrations. The beam envelope and the distorted emittance ellipses are obtained using the method of tracing ray trajectories. A 50 % increase in beam emittance was found due to aberrational effects when the ion beam goes through a strong decelerating-accelerating Einzel lens. The space charge effects are small over the range of intensities investigated (0<I<50*10-6 A). Measurements were performed on a test bench using the same model 860 negative ion source. The calculated results are roughly consistent with the measurements. Therefore, more reliable starting conditions than can be obtained from linear calculations are now available to design the downstream transport system.

52495 **(DOE/ER/06027—T1) [A high resolution projection electron spectrometers]: Final report 1978-1987.** (North Carolina Univ., Chapel Hill (USA)). [1988]. Contract AS05-78ER06027. 27p. (CONF-841117—55). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015780/JAW.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

The main emphasis of the work has been to study inner shell ionization processes. The signatures have been K x-rays or K Auger transitions. We have worked with semiconductor or Bragg x-ray spectrometers. Toward the end of the contract we concentrated on projectile electron spectroscopy. These topics and other atomic physics projects are described briefly in this progress report.

52496 **(DOE/ER/13491—379) Atomic physics with highly charged ions: Progress report, 15 August 1985--14 August 1988.** Richard, P. (Kansas State Univ., Manhattan (USA). J.R. MacDonald Atomic and Nuclear Science Lab.). Aug 1988. Contract FG02-86ER13491. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016544/JAW.

The study of inelastic collision phenomena with highly charged projectile ions and the interpretation of spectral features resulting from these collisions remain as the major focal points in the atomic physics research at the J.R. Macdonald Laboratory, Kansas State University, Manhattan, Kansas. The title of the research project "Atomic Physics with Highly Charged Ions" speaks to these points. The experimental work is made possible locally by the use of relatively high velocity, highly charged projectiles (v typically 5% c) as obtained from the 6 MV tandem Van de Graaff accelerator. The work in the past few years has divided into collisions at high velocity using the primary beams from the accelerator and collisions at low velocity using secondary beams (recoil ions produced in a high velocity collision) in a so-called SIRS (Secondary Ion Recoil Source) geometry. Theoretical calculations have been performed to accurately describe inelastic scattering processes of the one-electron and many-electron type, and to accurately predict atomic transition energies and intensities for x-rays and Auger electrons. Correlation effects and polarization phenomena in ion-atom collisions have been investigated.

52497 **(DOE/ER/13630—2) Many-body processes in atomic and molecular physics: Progress report, September 1, 1986-August 31, 1988.** Shih-I, Chu. (Kansas Univ., Lawrence (USA). Dept. of Chemistry). Feb 1988. Contract FG02-86ER13630. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016533/JAW.

This report discusses progress in the following topics: Complex-Coordinate Coupled-Channel Methods for Autoionization, Predissociation, and Multiphoton Resonances; Intensity-Dependent Ionization Potential and Above-Threshold Multiphoton Ionization; Collisonal Processes in the Presence of Laser Fields; Floquet-Liouville Supermatrix Approach to Intense Field Multiphoton and Nonlinear Optical Processes; and Classical Time-Dependent Self-Consistent Field Approach to Intense Field Multiphoton Dissociation of Molecules.

52498 **(DOE/ER/53188—T2) Experimental investigation of electron capture from atomic hydrogen and deuterium by alpha particles: Progress report, 15 September 1987-14 September 1988.** Gay, T.J. (Missouri Univ., Rolla (USA)). Aug 1988. Contract FG02-84ER53188. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015631/JAW.

During the last nine months, we have made several improvements to the apparatus, measured differential and total cross sections for the reaction, He{sup ++} + He{1s{sup 2}} {yields} He({Sigma}n,{ital ell})+He{sup ++}, and some important progress in understanding the physics of ionizing collisions relevant for fusion plasmas. 6 refs., 5 figs.

52499 **(KFK—4356) Moessbauer effect studies on the molecular structure of some organometallic /sup 237/Np compounds under paramagnetic relaxation.** Adrian, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Jan 1988. 147p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754348/JAW.

The molecular structure of some organometallic /sup 237/Np compounds with the general chemical formulae Np(C/sub 5/H/sub 5/)/sub 3/X (X = halogenide, pseudo halogenide, alkyle or acetylide, aromatic or non-aromatic ring systems), Np(C/sub 5/H/sub 5/)/sub 3/X/sub 2/ (X = NCCH/sub 3/, NCS/sup -/), Np(C/sub 8/H/sub 8/)/sub 2/ and Np/sup III/(C/sub 5/H/sub 5/)/sub 3/*B (B = OC/sub 4/H/sub 8/, O(C/sub 2/H/sub 5/)/sub 2/) was investigated by using Moessbauer spectroscopy. The aim was to gain deeper understanding of the nature of the covalent bond of actinide ions. By observing the hyperfine interaction of the nuclear states of /sup 237/Np (isomeric shift, quadrupole splitting and paramagnetic hyperfine coupling), information was obtained on the distribution of charge and spin density around the Np ion and on the symmetry of the molecule. For a quantitative analysis of the spectra a model was developed which describes the splitting of the nuclear states by an asymmetric quadrupole splitting and an anisotropic paramagnetic hyperfine coupling, which are observed simultanously. The spectra are highly influenced by paramagnetic relaxation effects. For a quantitative description of these effects, the theoretical treatment of the Moessbauer line shape under paramagnetic relaxation by Hirst (1970) was taken as a basis and applied to the special case of /sup 237/Np. A possible anisotropy of the relaxation frequencies can also be considered. Thereby the expected low symmetry of the complexes is taken into account. With the developed model, the spectra of most of the studied compounds could be described quantitatively. (orig./GSCH).

52500 **Raman spectra of selected transuranium trihalides in the solid state.** Wilmarth, W.R.; Begun, G.M.; Haire, R.G.; Peterson, J.R. (Department of Chemistry, University of Tennessee, Knoxville, Tennessee 37996-1600). *Journal of Chemical Physics;* **89**: No. 8, 4666-4670(15 Oct 1988).

Raman spectral data have been obtained from a number of transuranium trihalides in the solid state. The Raman spectra of these actinide compounds are reported and compared to the published Raman spectra of isostructural compounds. Tentative symmetry assignments have been made for the observed Raman-active lattice vibrations based on nuclear site symmetry analysis of their respective crystal structures and comparisons to the symmetry assignments made for isostructural lanthanide compounds. The Raman spectral data obtained in this study represent a partial data base for the use of Raman spectroscopy for identifying the crystal structures exhibited by these and isostructural compounds.

52501 **Theoretical study of the interaction of Fe, Fe^+, and FeCO with Ar.** Braga, M.; Almeida, A.L.; Taft, C.A.; Hammond, B.L.; Lester W.A. Jr. (Departamento de Quimica Fundamental, Universidade Federal de Pernambuco, 50000 Recife, Pernambuco, Brasil). *Journal of Chemical Physics;* **89**: No. 8, 4867-4870(15 Oct 1988).

Ab initio Hartree—Fock calculations were performed on FeAr and $FeAr^+$ in order to determine the interaction of both neutral and singly-ionized Fe atoms trapped in Ar, and on ArFeCO and FeCOAr in order to ascertain the effect of an Ar matrix on the FeCO molecule. Quadrupole splittings and isomer shifts are computed using ab initio orbital populations and charge densities scaled by a relativistic factor. Good agreement between calculated and experimental hyperfine parameters is found in each case. The interaction energy for Fe^+—Ar has been computed by ab initio Hartree—Fock and effective-core potential (ECP) methods. Both approaches yield a minimum between Fe^+ and Ar at approximately 7.6 bohr.

52502 **Density driven self-consistent field method. I. Derivation and basic properties.** Cioslowski, J. (Los Alamos National Laboratory, Theoretical Division, Group T-12, MS J569, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 8, 4871-4874(15 Oct 1988).

An explicit Schroedinger-like equation for the Hartree—Fock density amplitude (square root of the electron density) is derived. The potential contains a classical electrostatic part as well as the exclusion potential that arises from the Fermi statistics of the electrons. The exclusion potential is explicitly determined by solving a system of equations for auxiliary functions. Basic features of the new approach are discussed and its equivalence to the standard HF method is demonstrated.

52503 **Theoretical study of $B_2H^+_5$, $B_2H^+_6$, and B_2H_6.** Curtiss, L.A.; Pople, J.A. (Argonne National Laboratory, Chemical Technology Division/Materials Science Program, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **89**: No. 8, 4875-4879(15 Oct 1988).

A theoretical study is presented of $B_2H^+_5$, $B_2H^+_6$, and B_2H_6 at a high level of theory, including correlation energy beyond fourth-order perturbation theory and large basis sets. The $B_2H^+_5$ ion is predicted to have a triply hydrogen-bridged structure, with a calculated appearance potential in agreement with a recently measured value by photoionization. The most stable $B_2H^+_6$ ion found corresponds to a very weakly bound complex between $B_2H^+_5$ and H, likely to exist only in a metastable state.

52504 **Vibrational relaxation rates via equilibrium simulation of fluids: Thermal softening.** Visscher, P.B.; Holian, B.L. (Department of Physics, University of Alabama, Tuscaloosa, Alabama 35487-1921). *Journal of Chemical Physics;* **89**: No. 8, 5128-5136(15 Oct 1988).

In this paper we report the results of one-dimensional simulations of vibrational relaxation in a dense classical molecular fluid. The novel feature of the simulations is that we collect statistics on the energy transfer from vibrational to translational modes in individual collisions, instead of just monitoring the total vibrational energy of the system. This gives much more information on the microscopic processes involved, and in particular reveals that under a wide range of conditions the vibrational relaxation rate is dominated by an effect which we refer to as "thermal softening" of the vibration frequency. This effect is very important in defining and calculating the vibrational relaxation rate.

52505 **Green—Kubo formula for collisional relaxation.** Visscher, P.B. (Los Alamos National Laboratory and University of Alabama, Tuscaloosa, Alabama 35487-1921). *Journal of Chemical Physics;* **89**: No. 8, 5137-5139(15 Oct 1988).

In this paper we generalize the Green—Kubo method (usually used for obtaining formulas for transport coefficients involving conserved densities) to relaxation processes occurring during collisions, such as the transfer of energy from vibrational to translational modes in a molecular fluid. We show that the relaxation rate can be calculated without evaluating time correlation functions over long times, and can in fact be written as a sum over collisions which makes the relation between the Green—Kubo method and approximate independent-collision models much clearer.

52506 **Conformational statistics of random polyelectrolyte chain in theta region and transition to collapse: Qualitative study.** Qian, C.; Kholodenko, A.L. (Department of Chemistry, Clemson University, Clemson, South Carolina 29634-1905). *Journal of Chemical Physics;* **89**: No. 8, 5273-5279(15 Oct 1988).

We study conformational properties of the polyelectrolyte chain with prescribed Bernoullian distribution of positive and negative charges on its backbone. For the case when the total charge of

the chain is almost zero, the charge fluctuations are of special importance leading to the collapse transition qualitatively different from that expected for the uncharged homopolymers. The present case of collapse transition directly demonstrates the biological significance of nonuniformly charged polymers.

52507 **Stimulated resonance Raman spectroscopy: An alternative to laser-rf double resonance for ion spectroscopy.** Young, L.; Dinneen, T.; Mansour, N.B. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3812-3815(1 Oct 1988).

Stimulated resonance Raman spectroscopy is presented as an alternative to laser-rf double resonance for obtaining high-precision measurements in ion beams. By use of a single-phase modulated laser beam to derive the two required fields, the laser—ion-beam alignment is significantly simplified. In addition, this method is especially useful in the low-frequency regime where the laser-rf double-resonance method encounters difficulties due to modifications of the ion-beam velocity distribution. These modifications, which result from interaction with the traveling rf wave used to induce magnetic dipole transitions, are observed and quantitatively modeled.

52508 **Characteristics of close collisions of an antiproton with atoms.** Kimura, M.; Inokuti, M. (Argonne National Laboratory,p 9700 S. Cass Ave., Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3801-3803(1 Oct 1988).

We discuss low-energy antiproton (p-bar) collisions with H and He on the basis of adiabatic potentials and with the use of a molecular-orbital expansion method. Every electronic state for the p-bar-H system merges into the continuum at a certain internuclear separation, and this separation is farther and farther out for higher and higher excited states. (This fact was first pointed out by E. Fermi and E. Teller [Phys. Rev. 72, 399 (1947)], who specifically considered the ground state of a system consisting of a meson and a hydrogen atom.) For the p-bar-He system, as for to the p-bar-H system, all electronic states cross over into the continuum of the $He^+ + 1e^-$ state at a finite separation. These findings lead us to suggest that a close encounter of p-bar with an atom should result, at a high probability, in ionization with near-zero electron energy and a wide range of ejected-electron angle. This mechanism of ionization is absent for collisions of protons (p), and may account in part for the greater double-ionization cross section of He for p-bar than for p at the same energy, which was found in a recent experiment.

52509 **Effects of relativity and configuration interaction on dielectronic recombination of hydrogenlike ions.** Chen, M.H. (High Temperature Physics Division, University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3280-3285(1 Oct 1988).

Effects of configuration interaction and relativity on the dielectronic satellite spectra and total dielectronic rate coefficients for the hydrogenlike ions were investigated. The calculations were carried out for the intermediate autoionizing states of the 2121′ and 2131′ configurations by using relativistic and nonrelativistic Hartree-Fock models. The effect of relativity has been found to change the Auger rates by as much as a factor of 18 at Z = 54. The inclusion of the Breit interaction in calculations of the Auger matrix elements could change the Auger rates by as much as a factor of 4 for the Xe/sup 52+/ ion. The effect of configuration interaction has been found to alter some of the transition rates by a factor of 2. The dielectronic satellite spectra become much more complex due to the inclusion of configuration interaction and intermediate coupling. The effects of relativity and configuration interaction, however, have been found to change the total dielectronic recombination coefficients by amounts less than 20% and a few percent, respectively, for the Cr/sup 23+/ and Xe/sup 53+/ ions.

52510 **Autoionizing resonances in electron-impact excitation of oxygenlike selenium.** Reed, K.J.; Chen, M.H.; Hazi, A.U. (High Temperature Physics Division, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3319-3326(1 Oct 1988).

We have investigated the contributions of doubly excited, autoionizing resonances to the rate coefficients for electron-impact excitation of the n = 2 to n = 2 transitions in oxygenlike selenium. The cross sections for direct excitation were calculated using a relativistic distorted-wave approximation. The detailed Auger and radiative rates required for evaluating the resonance contributions were calculated using a multiconfigurational Dirac-Fock model. The largest effect is on the electric-dipole-forbidden transitions. For some J = 0 to J = 0 transitions involving two-electron excitations, the resonances enhance the collisional excitation rates by factors up to 10^4 at electron temperatures relevant for laboratory plasmas.

52511 **Transitions between the n = 2 fine-structure levels in H+p collisions.** Struensee, M.C.; Cohen, J.S. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3377-3387(1 Oct 1988).

The transitions between the 2S and 2P states of a hydrogen atom in collisions with a proton are examined. Inclusion of electron spin, neglected in previous treatments, is shown to be crucial for the rigorous formulation of the problem. In a basis of the eight n = 2 eigenfunctions, a first-order system of coupled differential equations is obtained by assuming classical straight-line trajectories. The solution of these equations yields the cross sections as functions of velocity. The cross sections are used to compute the transition rates in a plasma over a wide range of temperatures.

52512 **Electron-impact coherence parameters for excitation of the ^1P states in helium.** Csanak, G.; Cartwright, D.C. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 6, 2740-2761(15 Sep 1988).

First-order many-body theory (FOMBT) has been used to calculate differential cross sections (DCS's) and electron-impact coherence parameters (EICP's) associated with excitation of the n^1P (n = 2,3) electronic states of helium for incident-electron energies in the range 22 eV ≦E≦500 eV. The DCS's predicted by FOMBT agree reasonably well with the available experimental data and in the 50 eV ≦E≦500 eV energy range, as well as, or better than, those predicted by any other theory. The EICP's predicted by R-matrix methods are found to agree better with the available experimental data in the threshold region (E≦30 eV) than those predicted by FOMBT. However, in the intermediate-energy region, 50 eV ≦E≦500 eV, FOMBT provides EICP results that are in semiquantitative agreement with the available data. Partial-wave decompositions of the <L/sub perpendicular/> parameter at various incident-electron energies show that the structure observed in this parameter is caused by interference among the free-electron partial waves and that the small-angle characteristics of this parameter are determined principally by low-l partial waves, i.e., by incident electrons with small-impact parameters. Additional experimental measurements and results from more elaborate calculations at intermediate and large scattering angles and for intermediate and high incident-electron energies are needed to resolve a number of issues associated with the interpretation of the EICP's.

52513 **Dielectronic recombination of the B-like ions: N/sup 2+/, O/sup 3+/, and F/sup 4+/.** Dittner, P.F.; Datz, S.; Hippler, R.; Krause, H.F.; Miller, P.D.; Pepmiller, P.L.; Fou, C.M.; Hahn, Y.; Nasser, I. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6377). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 6, 2762-2766(15 Sep 1988).

The first measurements of dielectronic recombination rate coefficients associated with the 2s→2p excitation in the B-like ions (N/sup 2+/, O/sup 3+/, and F/sup 4+/) are reported. In this case, three levels (^2D, ^2S, and ^2P) of the excited state exist and are partially resolved. We observed the amount of electron capture attending the passage of MeV/nucleon ion beams through a collinear, magnetically confined, space-charged-limited electron beam as a function of relative energy. The experimental rate coefficients are consistent in magnitude with rates determined from distorted-wave calculations of the dielectronic recombination cross sections.

52514 **Resonantly enhanced multiphoton ionization of krypton and xenon with intense ultraviolet laser radiation.** Perry, M.D.; Landen, O.L. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 6, 2815-2829(15 Sep 1988).

The absolute yield of singly and multiply charged ions of krypton and xenon and resulting photoelectron spectra produced by intense laser radiation in the range 285—310 nm are presented. Enhancement of the yield of Kr^+ by two orders of magnitude in the vicinity of the $4p^5 4d$ and $4p^5 4d'$ manifolds is observed at intensities exceeding 10/sup 13/ W/cm^2. These observations extend the intensity at which strong resonant enhancement has been observed in multiphoton ionization by two orders of magnitude. A model incorporating line shifts and linewidths scaling linearly with intensity is in good agreement with the experimental results. Absolute cross sections for multiphoton ionization of xenon and krypton are presented and compared with recent theoretical calculations.

52515 **Nonlinear optical processes in xenon and krypton studied by two-color multiphoton ionization.** Blazewicz, P.R.; Miller, J.C. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Post Office Box 2008, Oak Ridge, Tennessee 37831-6125). *Physical Review [Section] A: General Physics;* **38**: No. 6, 2863-2870(15 Sep 1988).

Multiphoton ionization (MPI) and third-harmonic generation (THG) in xenon and krypton have been studied via three-photon resonance with the xenon $6s'[1/2]_1{}^o$ and krypton $5s[(3/2)_1{}^o$ states. A second, tunable dye laser is used to couple these states to higher-lying even-parity states. Observations are reported regarding the third-harmonic related cancellation of the intermediate s-state population and the mechanisms of population of the final states. Effects of the four-photon resonance on THG are detailed. Changes induced by the second laser reduce THG in normally favorable regions and enable it in otherwise forbidden regions. Striking effects in the MPI spectra due to the changes induced in THG are reported.

52516 **Alternative nonlinear-optical expansion and diagrammatic approach: Nth-order dephasing-induced effects.** Trebino, R. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 6, 2921-2931(15 Sep 1988).

We show that dephasing-induced nonlinear-optical effects whose amplitudes are proportional to trinomials of dephasing rates, Γ/sub i//sub j/+Γ/sub jk/-Γ/sub ik/, exist in all nonlinear orders of perturbation theory. To do this, we derive a new form for the perturbation expansion of the susceptibility, equivalent to the currently used expansion, but which writes each order as a sum of (1) terms due to single-sided diagrams, and (2) correction terms, all of which are proportional to trinomials of dephasing rates. The proof of this result utilizes a diagrammatic approach involving a new type of double-sided diagram for the latter terms. These diagrams immediately yield the terms proportional to trinomials of dephasing rates in all orders without the need for algebraic manipulation. This approach also reveals some general properties of the Nth-order susceptibility.

52517 **Laser optical pumping of rare-gas metastable atom beams.** Butler, W.H.; Hammond, M.S.; Lynn, J.G.; Dunning, F.B.; Walters, G.K. (Department of Physics and the Rice Quantum Institute, Rice University, Houston, Texas 77251). *Review of Scientific Instruments;* **59**: No. 9, 2083-2084(Sep 1988).

Time-of-flight techniques are used to demonstrate the very high rare-gas metastable atom polarizations that can be achieved in a beam through optical pumping with a simple frequency-modulated multimode dye laser.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 51560, 51561, 51900, 52756, 52864

52518 **(AD-A—193765/5/XAB) Theoretical investigation of laser-sustained plasma thruster. Report for 1 September 1986-31 August 1987.** Jeng, S.M.; Keefer, D. (Tennessee Univ., Tullahoma (USA). Space Inst.). 21 Apr 1988. 13p. NTIS, PC A03/MF A01.

A numerical code was successfully developed for the investigation of thruster performance using a laser-sustained hydrogen plasma as the propellant. The plasma was sustained using a 10.6 micrometer CO_2 laser beam which is focused at different positions within the thruster. The physical model assumed that plasma is in thermodynamically equilibrium (LTE), and geometric ray tracing was adopted to describe the laser beam. The steady-state, axisymmetric, Navier-Stokes equations coupled with the laser power-absorption process have been solved numerically. A pressure-based Navier-Stokes numerical solver using body-fitted coordinates was used to calculate the laser-supported rocket flow which includes both subsonic and supersonic flow regions. From the limited parametric study, which did not try to optimize the rocket performance, it was found that better performance was obtained when the laser beam was focused closer to the rocket throat.

52519 **(CONF-8805106—) Proceedings of the sixth symposium on energy engineering sciences: Flow and transport in continua.** (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 227p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88016751/JAW.

From 6. symposium on energy engineering sciences; Argonne, IL, USA (4 May 1988).

This report contains papers on the following topics: transport of heat; fluid flow; non-equilibrium system; multiphase flow; porous media; and combustion. (JDB)

52520 **(KFK—4353) Numerical simulations of compressible hydrodynamic instabilities.** Munz, C.D.; Schmidt, L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). May 1988. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754581/JAW.

This paper presents results for the numerical simulation of compressible hydrodynamic interface instabilities. The numerical results are produced by the direct simulation via numerical solution of the two-dimensional Euler equations. The numerical method considered here is a MUSCL-type scheme and belongs to the class of high resolution schemes. We study the instabilities of interfaces separating two domains of a fluid which move at different velocities, namely the Kelvin-Helmholtz instability, the Rayleigh-Taylor instability and the instability of jets. The interfaces are treated in a Lagrangean fashion according to the calculated Eulerian flow field.

52521 **(LA-UR—88-1743) Nonlinear stability of ideal fluid equilibria.** Holm, D.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 67p. (CONF-8806161—2). NTIS, PC A04/MF A01. Order Number DE88014477/JAW.

From Enrico Fermi School of Physics on nonlinear topics in ocean physics conference; Varenna, Italy (26 Jun 1988).

The Lyapunov method for establishing stability is related to well- known energy principles for nondissipative dynamical systems. A development of the Lyapunov method for Hamiltonian systems due to Arnold establishes sufficient conditions for Lyapunov stability by using the energy plus other conserved quantities, together with second variations and convexity estimates. When treating the stability of ideal fluid dynamics within the Hamiltonian framework, a useful class of these conserved quantities consists of the Casimir functionals, which Poisson-commute with all functionals of the dynamical fluid variables. Such conserved quantities, when added to the energy, help to provide convexity estimates that bound the growth of perturbations. These convexity estimates, in turn, provide norms necessary for establishing Lyapunov stability under the nonlinear evolution. In contrast, the commonly used second variation or spectral stability arguments only prove linear-

ized stability. As ideal fluid examples, in these lectures we discuss planar barotropic compressible fluid dynamics, the three-dimensional hydrostatic Boussinesq model, and a new set of shallow water equations with nonlinear dispersion due to Basdenkov, Morosov, and Pogutse[1985]. Remarkably, all three of these samples have the same Hamiltonian structure and, thus, possess the same Casimir functionals upon which their stability analyses are based. We also treat stability of modified quasigeostrophic flow, a problem whose Hamiltonian structure and Casimirs closely resemble Arnold's original example. Finally, we discuss some aspects of conditional stability and the applicability of Arnold's development of the Lyapunov technique. 100 refs.

52522 **(LA-UR—88-2600) MHD turbulence: Relaxation processes and variational principles.** Montgomery, D.; Phillips, L. (Los Alamos National Lab., NM (USA); Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy). Jun 1988. Contract W-7405-ENG-36;FG02-85ER53194. 23p. (CONF-8805120—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016341/JAW.

From CNLS conference on advances in fluid turbulence; Los Alamos, NM, USA (16 May 1988).

Turbulent relaxation processes seem to play a more prominent role in magnetohydrodynamics (MHD) than in hydrodynamics and exhibit a wider variety of behavior. In decaying turbulence, "relaxed" states can result from highly unequal decay rates of extensive, cascadable ideal invariants' such as energy, magnetic helicity, etc. In externally driven MHD systems, the relaxed states may result from other processes, less well understood. We are exploring a formulation based on a principle of the minimum rate of energy dissipation. This is a nineteenth century principle from which seems to descend the more modern (and less well accepted) principle of "the minimum rate of entropy production." Consequences of the conjectured principle are described for two cases. (1) For the reversed-field pinch (RFP), an externally-applied electric field supplies magnetic helicity at a constant rate. (2) For the case of a constant rate of dissipation of cross-helicity, a relaxed state with aligned vorticity and current densities is predicted. The former problem models the steady-state operation of a familiar fusion confinement device. The latter models certain features of solar wind turbulence, regarded as a driven, steady-state system. 51 refs.

52523 **(LA-UR—88-2654) Diffusion in lattice fluids.** Binder, P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-8809128—1). NTIS, PC A03/MF A01. Order Number DE88016331/JAW.

From Workshop in discrete kinetic theory; Torino, Italy (20 Sep 1988).

Diffusion is the transport of mass caused by molecular motion. In this article we review recent studies of the motion of one tagged particle in (a) a static, disordered medium, and (b) a bath of moving particles, both in two-dimensional lattices. We find in the first study that diffusion only exists if the particle-scatterer collision rules are nondeterministic. In the second study we find that the two-dimensional diffusion coefficient exists, apparently without a logarithmic divergence. We also find that several tagged-particle collisions rules are consistent with the moving particle rules, leading to the non-uniqueness of the diffusion coefficient. These results are relevant to the a study of diffusion in lattice gas automata. 17 refs., 1 fig.

52524 **Three-fluid simulation of the plasma-erosion-opening switch.** Mason, R.J.; Jones, M.E.; Grossmann, J.M.; Ottinger, P.F. (Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **64**: No. 8, 4208-4211(15 Oct 1988).

The dynamics of the plasma-erosion-opening switch is characterized with the aid of 2D three-fluid simulation using the ANt-smcapsh-smcapsEm-smcaps implicit simulation code, for plasma fill densities ranging from 10^{12} to 6 x 10^{13} cm^{-3} with 45-ns pulse rise times. The switch behavior is found to depend sensitively on the threshold for electron emission at the cathode, on the detailed structure of the anode with its injection holes, and on the possible action of anomalous resistivity in the fill plasma. Closest agreement with NRL GAMBLE I experimental results is obtained with the combination of zero electric field threshold emission at the cathode, an "open" anode, and modest anomalous resistivity.

52525 **New equations of motion for molecular dynamics systems that change shape.** Cleveland, C.L. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Journal of Chemical Physics;* **89**: No. 8, 4987-4993(15 Oct 1988).

In the methods of molecular dynamics a large system is frequently subdivided into smaller regions which are periodic replications of each other. This subdivision defines the "computational cell" and may be performed in a number of equivalent ways, all producing cells of different shapes but of the same size and containing equivalent sets of particles. We consider the requirement that the form of the equations of motion be invariant under transformations connecting such equivalent computational cells. Since none of the equations of motion of the Parrinello—Rahman family proposed so far satisfy this condition, we construct some which do. These new equations are more practically useful than their antecedents for studies of systems whose computational cells may undergo extensive changes in shape, especially for studies of yield and flow under an applied stress.

52526 **Hamiltonian formulation of inviscid flows with free boundaries.** Abarbanel, H.D.I.; Brown, R.; Yang, Y.M. (Institute for Nonlinear Science, Department of Physics, and the Marine Physical Laboratory of the Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California 92093). *Physics of Fluids;* **31**: No. 10, 2802-2809(Oct 1988).

The formulation of the Hamiltonian structures for inviscid fluid flows with material free surfaces is presented in both the Lagrangian specification, where the fundamental Poisson brackets are canonical, and in the Eulerian specification, where the dynamics is given in noncanonical form. The noncanonical Eulerian brackets are derived explicitly from the canonical Lagrangian brackets. The Eulerian brackets are, with the exception of a single term at each material free surface separating flows in different phases, identical to those for isentropic flow of a compressible, inviscid fluid. The dynamics of the free surface is located in the Hamiltonian and in the definition of the Eulerian variables of mass density, rho(x, t), momentum density, M(x,t) [which is rho times the fluid velocity v(x,t)], and the specific entropy, $\sigma(x,t)$. The boundary conditions for the Eulerian variables and the evolution equations for the free surfaces come from the Euler equations of the flow. This construction provides a unified treatment of inviscid flows with any number of free surfaces.

52527 **Chaotic flows and fast magnetic dynamos.** Finn, J.M.; Ott, E. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **31**: No. 10, 2992-3011(Oct 1988).

Given a prescribed flow of an initially unmagnetized conducting fluid, one can ask if a small seed magnetic field will amplify exponentially with time. This is called the kinematic dynamo problem. In many cases of interest (particularly in astrophysics), very high electrical conductivity of the fluid (high magnetic Reynolds number R/sub m/) is relevant. In this paper the kinematic dynamo problem is considered in the R/sub m/ $\rightarrow\infty$ limit (the "fast" kinematic dynamo). It appears that an important ingredient for a kinematic dynamo in this limit is that the orbits of fluid elements in the flow be chaotic. In this paper it is shown that the magnetic field tends to concentrate on a zero volume fractal set, and, in addition, tends to exhibit arbitrarily fine-scaled oscillations between parallel and antiparallel directions. Idealized analyzable examples exhibiting these properties are presented, along with numerical computations on more typical examples. For the latter a numerical technique for treating fast dynamos is developed and its properties are discussed. The relation of the dynamo growth rate to quantitative measures of chaos, namely, the Lyapunov exponent and topological entropy, is also discussed.

52528 Comment on "Spectrum, dimension, and polymer analogies in fluid turbulence". Kraichnan, R.H. (303 Potrillo Drive, Los Alamos, New Mexico 87544). *Physical Review Letters;* **61**: No. 13, 1522-1522(26 Sep 1988).

A Comment on the Letter by A. J. Chorin, Phys. Rev. Lett. 60, 1947 (1988).

52529 Chorin replies. Chorin, A.J. (Department of Mathematics, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 13, 1524-1525(26 Sep 1988).

A controversy regarding the use of a statistical mechanical tool developed in polymer theory to vertex systems and the study of turbulence is cleared. (AIP)

52530 Natural convection in shallow enclosures with differentially heated endwalls. Paolucci, S.; Chenoweth, D.R. (Applied Mechanics Department, Sandia National Laboratories, Livermore, CA 94550). *Journal of Heat Transfer;* **110**: No. 3, 625-634(Aug 1988).

We consider a low-aspect-ratio two-dimensional rectangular cavity, differentially heated with an arbitrarily large horizontal temperature difference. Steady-state results obtained from numerical solutions of the transient Navier—Stokes equations are given for air using the ideal gas law and Sutherland law transport properties. We clarify the different flow regimes possible by using numerical results for aspect ratios $0.025 \leqq A \leqq 1$ and for Rayleigh numbers (based on height) $10^2 \leqq Ra \leqq 10^9$. We present Nusselt numbers, and temperature and velocity distributions, and compare them with existing data. At high Ra in the Boussinesq limit we show the existence of weak secondary and tertiary flows in the core of the cavity. In addition we present novel solutions in the non-Boussinesq regime. We find that the classical parallel flow solution, accurate in the core of the cavity in the Boussinesq limit, does not exist when variable properties are introduced. For higher Rayleigh numbers, we generalized the well-known analytical boundary layer solution of Gill. The non-Boussinesq solutions show greatly reduced static pressure levels and lower critical Rayleigh numbers.

6450 High Energy Physics

52531 (DOE/ER—0380) Report of the HEPAP [High Energy Physics Advisory Panel] Subpanel on Future Modes of Experimental Research in High Energy Physics. (USDOE Office of Energy Research, Washington, DC. High Energy Physics Div.). Jul 1988. 107p. NTIS, PC A06; 3; GPO Dep. Order Number DE88016503/JAW.

Particle physics is the study of matter and its interaction on the most microscopic of scales. Since mid-century, our view of the most elementary forms of matter has shifted from the neutrons, protons, and electrons that make up atoms to the more pointlike quarks and leptons. Although open questions and challenges abound, a comprehensive picture that successfully describes these entities and their interactions on a scale down to at least 10^{-16} cm has been forged through the intellectual efforts of experimental and theoretical physicists alike. The strides taken have been aided by accelerators of ever increasing energy and, correspondingly, ever increasing physical size. The nature of experimental research has gradually changed over the years from individual and small group efforts to large team projects involving hundreds of physicists. Among other things, it is our purpose in this report to examine how one can continue this research, which is now often on a massive scale, in ways that best preserve the qualities of individual, intellectual input. 1 fig., 5 tabs.

52532 (DOE/ER/02289—T6) High energy experimental physics: Progress report. Rosen, J.; Miller, D. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy). 27 Jun 1988. Contract AC02-76ER02289. 176p. NTIS, PC A09. Order Number DE88012968/JAW.

This report contains papers of high energy physics experiments and detector equipment design. Proposals are also given for future experiments. Some of the topics covered in this report are: high energy predictions for {bar char}pp and pp elastic scattering and total cross sections; D0 forward drift chambers; polarized beam facility; analyzing power measurment in inclusive pion production at high transverse momentum; Skyrme model for baryons; string models for color flux tubes; hadronic decays for the {tau} lepton; and meson form factors in perturbative QCD. (LSP)

52533 (JINR—D-1,2-86-668) Proceedings of the 8. International seminar on high energy physics problems. V. 2. Multiquark interactions and quantum chromodynamics. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 360p. (CONF-8606164—). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW.

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Individual papers are indexed separately.

52534 (LBL—25150) Hadron collisions at TEV energies. Cahn, R.N. (Lawrence Berkeley Lab., CA (USA)). 10 May 1988. Contract AC03-76SF00098. 12p. (CONF-8805184—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016642/JAW.

From Shulamit Goldhaber memorial lecture; Tel Aviv, Israel (4 May 1988).

This paper discusses the need for higher energy accelerators to probe the mysteries of the subatomic universe. Intermediate vector bosons are discussed as well as symmetry breaking and the standard model. (LSP)

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 51951, 52668

52535 (BNL—41496) Search for the decay $K^+ \rightarrow \pi^+ \mu^+ e$/sup {minus}/. Zeller, M.E.; Alliegro, C.; Campagnari, C.; Hadley, N.J.; Lee, A.M.; Gordon, H.A.; Lazarus, D.M.; Rehak, P.; Cooper, P.S.; Egger, J.; Herold, W.D.; Kaspar, H.; Chaloupka, V.; Jagel, E.A.; Lubatti, H.J. (Brookhaven National Lab., Upton, NY (USA); Yale Univ., New Haven, CT (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA); Paul Scherrer Inst. (PSI), Villigen (Switzerland); Washington Univ., Seattle (USA). Dept. of Physics). 31 May 1988. Contract AC02-76CH00016. 10p. (CONF-880867—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015852/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

A search for the lepton-flavor violating decay $K^+ \rightarrow \pi^+ \mu^+ e^-$ has been performed. Measurements have also been made of the branching ratio and decay particle distributions for the decay $K^+ \rightarrow \pi^+ e^-$. A description of the measurement technique, and preliminary results are presented. 6 refs., 5 figs.

52536 (BNL—41564) Intranuclear cascade study of the hadron-nucleus interactions at 1 GeV/c. Divadeenam, M.; Ward, T.E. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-8805142—21; BNL/NPB—88-78). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015718/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The proton inclusive spectra measured with 800 MeV/c π^+ beam (BNL) on light nuclei, and the 600 MeV/c {bar p} beam (LEAR) on ^{6}Li and ^{63}Cu have been successfully interpreted in terms of the Intranuclear Cascade (INC) Model. According to the INC model predictions the {bar p} induced reaction results in high pion yield for the light ^{6}Li target case. This is attributed to the nonavailability of nucleons to be knocked out by the pions produced following the {bar p} annihilation. While in this case of the heavier ^{63}Cu target some of the internally produced pions are subsequently absorbed leading to thermal equilibrium of the nuclear medium, resulting in a softer proton spectrum at the high energy end. Based on the INC model predictions the K^+ induced reactions could be studied to search for the "true resonances" beyond 1 GeV K^+ energy. 10 refs., 5 figs.

52537 **(CEA-N—2565) Measurement of the missing transverse energy in the UA1 experiment. Possible interpretations and futurs.** Zaganidis, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Jun 1988. 360p. (In French). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88754944/JAW.

The analysis of events with a large missing transverse energy (E/sub T//sup miss/) produced in the hadronic collisions, constitutes a very powerful method for testing the Standard Model and to search for new phenomena. We have analysed the events produced at the CERN pantip Collider (UA1 experiment) with a large missing transverse energy with one or several jets. Among this sample of events, we found a signal from theiota lepton which is produced from the decay of the W, by observing the iota's decay into hadrons. Using this analysis, we place an upper limit on the masses of gluinos and squarks in the absence of a signal of their production. We use a realistic simulation of a 4π very fine-grained calorimeter to study the direct production of the gluinos and squarks in pp collisions (ACOL, TEVATRON, LHC, SSC) in association with the background coming from the Standard Model which is dominated by QCD jets and the W and Z production. In this scheme, after a study of the signal and background behaviour as a function of the cuts applied, the limits with each of these Colliders for discovering the gluino and squark masses are given.

52538 **(DOE/ER/03065—53) High energy physics: Progress report, December 1, 1987--November 30, 1988.** Walker, W.D.; Fortney, L.R.; Goshaw, A.T. (Duke Univ., Durham, NC (USA). Dept. of Physics). Aug 1988. Contract AS05-76ER03065. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016082/JAW.

This report discusses progress in High Energy Physics at Duke University. Some topics discussed are: hadroproduction of charm particles; hadron nucleus collisions; photoproduction of mesons; hadroproduction of 4 mesons and direct gamma rays; quark-gluon plasma search in {bar p}p collisions; and modifications of computer systems and detectors. (LSP)

52539 **(DOE/ER/03130—38C) A study of the weak neutral current and the electromagnetic properties of the muon neutrino.** Diwan, M.V. (Brown Univ., Providence, RI (USA). Dept. of Physics). Jul 1988. Contract AC02-76ER03130. 150p. (COO—3130T-38C). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88015399/JAW.

The E-734 data on neutrino electron and antineutrino electron scattering were accumulated during three different periods. Three papers were published about the analysis of data from the periods in 1981 and 1983. Analysis of data from the period in 1986 is the subject of this thesis. The analysis methods were improved in 1986 to reduce eyescanning of the data. With the additional data from 1986, we have improved the result on $\sin^2\theta$/sub ω/. Maximum likelihood fits were made by combining data from the 1981, 1983 and 1986 runs. From these fits we get measurements of the total cross sections for ν/sub μ/e $\rightarrow$ ν/sub μ/e and {bar {nu}}/sub μ/e $\rightarrow$ {bar {nu}}/sub μ/e scattering. We get a measurement of the ratio R which gives us a determination of $\sin^2\theta$/sub ω/. Fits to the cross sections give an improved limit for the charge radius and magnetic dipole moment of the muon neutrino. 43 refs., 59 figs., 15 tabs.

52540 **(DOE/ER/40315—154) Experimental medium energy physics: Annual progress report June 1987--May 1988.** (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). [1988]. Contract FG02-87ER40315. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016093/JAW.

This report discusses progress in experimental medium energy physics at Carnegie Mellon University. Some of the topics covered are: search for the $\xi(2230)$; hyperon-antihyperon production studies; relativistic proton-nucleus and heavy ion-nucleus collisions; H dibaryon physics; hypernuclear physics research; pion physics; H particle experiment design and development; and electron scattering. (LSP)

52541 **(FNAL-TM—1534) Comparison of muon flux measurements to Halo Monte Carlo predictions.** Stutte, L.G. (Fermi National Accelerator Lab., Batavia, IL (USA)). 18 Jul 1988. Contract AC02-76CH03000. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016748/JAW.

Experiment E-782 has been approved to run during the next fixed target cycle in a fast-spill muon beam aimed at the Tohoku bubble chamber, located in Lab F. New construction is necessary to provide this beam. Initial feasibility tests were carried out during the last fixed target run, measuring both muon fluxes and background halo rates, as a function of several parameters. These test results are compared in detail with the predictions of the Monte Carlo program HALO, and can be used as a benchmark for design of the final beamline. 3 refs., 16 figs.

52542 **(INIS-mf—11761) Annihilation of antiproton and proton into charged mesons at low energies.** Dworschak, K. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 69p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754324/JAW.

The present thesis describes an experiment performed at the Low Energy Antiproton Ring LEAR (CERN) which allows via the simultaneous measurement of the differential elastic and charge-exchange cross section as well as the annihilation into charged and neutral mesons the study of the antiproton-proton interaction at low energies. This thesis especially deals with the evaluation of the annihilation cross sections into charged mesons in a momentum range from 160 to 600 MeV/c which were taken up in 2 beam times in November '85 and April '86. From the global slope of the annihilation cross sections by a comparison with the black disk model of the scattering theory it can be concluded that already at low energies a strong P-wave contribution is present. Furthermore the slope of the excitation function shows a steep increasement which deviates from the purely empirical 1/p behaviour to be expected. Indeed at low energies yet uncertainties exist. The error sources based on beam instabilities were between 400 and 600 MeV/c accurately studied. Regarding a systematic error of 0.65% yet present the resonance at about 500 MeV/c (S meson) reported in earlier experiments could be excluded and with a confidence limit of 90% an upper limit of 10 mbMeV be put.

52543 **(INIS-mf—11772) Detection of electrons from semileptonic decays of charm and bottom quarks produced by e/sup +/e/sup -/-annihilation at c.m. energies of 35 GeV.** Hellenbrand, K.H. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1987. 176p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754331/JAW.

The heavy quarks c and b produced in e/sup +/e/sup -/ annihilation at 35 GeV c.m. energy were detected via their semileptonic decay into electrons. Electrons are identified by measurement of dE/dx in the internal detector and by agreement of the momentum with the energy deposited in the lead-glass shower counter. A hadron rejection of 3x10/sup -3/ is reached at a detection probability for electrons from b decays of (41.5 +- 1.0)% and for electrons from c decays of (28.0 +- 1.0)%. By a small alteration of the cuts a hadron rejection of 10/sup -3/ is possible at only 20% signal loss. The transverse mass M/sub T/ and the transverse momentum p/sub T/ are used as separation variables. It is shown that events with b -> e and b -> c -> e can be discriminated sufficiently well from events with c -> e and background processes. The two latter event types however cannot be separated. For all occurring processes by means of model calculations weighting functions rho/sub i/(M/sub T/, p/sub T/) are established. By fitting of the (M/sub T/, p/sub T/) distribution in a chi/sup 2/ fit the weighted mean semileptonic branching ratios are determined to V/sub c/ = (7.8 +- 3.7/sub -2.0//sup +1.1/)% and V/sub b/ = (10.1 +- 1.9 +- 1.3)%. A maximum likelihood fit in which additionally to M/sub T/ and p/sub T/ also the thrust axis is used as variable yields for the charge asymmetries the results A/sub c/ = -0.21 +- 0.14/sub -0.05//sup +0.06/ and A/sub b/ = -0.04 +- 0.16/sub -0.06//sup +0.04/. From this the coupling constants a/sub c/ = 1.7/sub -1.1-0.5//sup +1.4+0.6/ and a/sub b/ = 0.3 +- 1.0/sub -0.4//sup +0.3/ are calculated. The first error is each the statistical and the second the

systematical. The results are in good agreement with other experimental results and with theoretical predictions.

52544 (INIS-SU—46, pp 28-31) **Inclusive differential cross sections of π/sup 0/-meson photoproduction on /sup 6/Li, /sup 12/C, /sup 27/Al, Cu, Cd nuclei at small angles in the 300-450 MeV γ quanta energy range.** Belousov, A.S.; Vazdik, Ya.A.; Malinovskij, E.I.; Rusakov, S.V.; Smirnov, P.A.; Solov'ev, Yu.V.; Usik, A.P.; Terkulov, A.R.; Fomenko, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780179/JAW.

Kratkie Soobshcheniya po Fizike.; (no.9).

In Experimental and theoretical physics. Collection.

The results of specification of data on inclusive differential cross sections of π/sup 0/-meson photoproduction on /sup 6/Li, /sup 12/C, /sup 27/Al, Cu, Cd nuclei (Cu, Cd is a natural isotope mixture) previously published, are presented. A thorough selection of events is performed and device parameters are specified. The measurements are made at the 'Gamma' device at the 'Pachra' electron synchrotron with the maximum energy of bremsstrahlung gamma-quanta of 850 MeV. The total systematic error varies from about 20% at 300 MeV to 16% at 440 MeV. The uncertainty in energy for which the device is set and uncertainty in spectrometer calibrations brings about uncertainty in the energy of measured points about +-8 MeV. 12 refs.; 3 figs.; 1 tab.

52545 (ITEF—40(1987)) **Production of heavy isobars in the π/sup -/p -> π/sup 0/π/sup +/π/sup -/π/sup -/p reaction at 4.5 GeV/c momentum.** Aleshin, Yu.D.; Prostova, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703291/JAW.

Investigation into the spectra of masses of δ /sup ++/PIPI particle system is conducted to reveal heavy isobars produced in PI/sup -/p->PI/sup 0/PI/sup +/PI/sup -/PI/sup -/p reaction at 4.5 GeV/c momentum. Excesses of events over the phase volume curve, which may be related to the production of well arranged N(1720) and N(2190) isobars are detected at 1720 and 2120 MeV/c/sup 2/ masses. Cross sections of these isobars are respectively: σ(N/sup */(2120)->Δ/sup ++/PI/sup 0/PI/sup -/)=57.8+-4.6 μb, σ(N/sup */(2120)->Δ/sup ++/PI/sup 0/PI/sup -/)=26+-3μb, σ(N/sup */(2120)->Δ/sup ++/rho/sup -/)=14.4+-2.3μb. The observed modes of N(1720) and N(2190) decays into Δ/sup ++/PI/sup 0/PI/sup -/ system refer to new earlier unknown decay channels. 8 refs.; 7 figs.

52546 (ITEF—92(1987)) **Helicity nonconservation in diffraction production of the b/sub 1//sup -/(1235) mesons in the π/sup -/P->b/sub 1//sup -/P reaction.** Aleshin, Yu.D.; Guzhavin, V.M.; Prostova, L.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703296/JAW.

Investigation of diffractive formation of b/sub 1//sup -/(1235) mesons in the π/sup -/p->b/sub 1-/p reaction is concluded, and angular characteristics of the decay b/sub 1//sup -/->π/sup (sup -)/ω/sup 0/ are studied. Based on the obtained data it is shown, that the mechanism of b/sub 1//sup -/ meson production in this reaction does not depend on energy and it is responsible for helicity nonconservation both in s- and in t-channels. 10 refs.; 4 figs.; 3 tabs.

52547 (ITEF—114(1987)) **Exotic baryon pπ/sup +/π/sup +/ states observation in the π/sup +/p -> pπ/sup +/π/sup +/π/sup -/ reaction.** Mikhajlichenko, V.I.; Drutskoj, A.G.; Morgunov, V.L.; Nikitin, S.Ya.; Kiselevich, I.L.; Shidlovskij, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703302/JAW.

Production of exotic baryon states in the π/sup +/p->pπ/sup +/π/sup +/π/sup (sub s-/- reaction, the π/sup +/ meson momentum being 4.23 GeV/c, was observed (where π/sub s//sup -/-π/sup -/-meson with p/sup */<0). Masses and widths of resonances observed in baryon exchange reactions are 1387+-15(8+-10), 1581+-15(73+-15), 1759+-13(76+-12) and 2074+-19(147+-41), respectively. 7 refs.; 2 figs.; 3 tabs.

52548 (ITEP—94(1987)) **Search for higher charmed strange states produced in ν-tildeN and νN interactions.** Asratyan, A.E.; Fedotov, A.V.; Goritchev, P.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703318/JAW.

The D*K decays of the (anti)neutrino-produced new charmed strange mesons with mass 2563.5 +- 5.2 MeV are observed. The decay width of this strongly decaying state is remarkably small: Γ <or approx. 25 MeV. 3 refs.; 1 tab.

52549 (JINR—D-1,2-86-668, pp 123-133) **Probing nuclear matter with dileptons.** Schroeder, L.S. (Lawrence Berkeley Lab., CA (USA)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The possibility to study nuclear matter using dilepton beams (e/sup +/e/sup -/, μ/sup +/μ/sup -/) in modern large accelerators is considered. The program of experiment performance on dilepton beams and their production in light ion reactions in the SPS CERN accelerator is discussed. Possile experiments in dilepton spectrometer of the Bevalac accelerator are also studied. A brief description of facilities for the experiment planning is given. 16 refs.; 8 figs.

52550 (JINR—D-1,2-86-668, pp 17-26) **Elastic electron-proton scattering at high Q/sup 2/.** Rock, S. (comp.; American Univ., Washington, DC; Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

In the framework of perturbative QCD and model of soft gluons elastic electron-proton scattering at large values of transferred momenta squares (Q/sup 2/) is considered. Spectrometer detectors are briefly described, and measurement results of elastic form factors of electrons and nucleons, elastic cross sections and their dependences on Q/sup 2/, obtained at SLAC, Saclay and Georgetown laboratories are given. The known experimental data and theoretical predictions of the models used are compared. Conclusions are made that the value Q/sup 4/G/sub M//sup P/ (where G/sub M//sup P/ - proton form factor) decreases in the range Q/sup 2/>12 (GeV/c)/sup 2/; perturbative QCD is applicable in elastic electron-proton scattering for Q/sup 2/$\leqq$31 (GeV/c)/sup 2/; model of soft gluons is also applicable for the description of proton form factor value and shape like perturbative QCD. 13 refs.; 9 figs.

52551 (JINR—R-1-87-559) **Observation of K(1629)-mesons.** Karnaukhov, V.M.; Moroz, V.I.; Koka, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Institutul Central de Fizica, Bucharest (Romania)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703377/JAW.

K(1629)-meson has been observed in π/sup -/p-interactions at 16 GeV/c in porcesses with K/sub S//sup 0/-, Λ-particle production. The parameters of the observed meson: M=(1629+-4) MeV/c/sup 2/, Γ=(13+-/sub 13//sup 16/) MeV/c/sup 2/. The compilative analysis of papers on the study of strange meson resonances in K/sup +-/p-, π/sup -/p-interactions at various energies confirms the results obtained. 31 refs.; 5 figs.; 6 tabs.

52552 **(LA-UR—88-2608) Tritium neutrino mass experiments.** Robertson, R.G.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-8804184—1). NTIS, PC A03/MF A01. Order Number DE88016340/JAW.

From 9. workshop on grand unification; Aix-Les-Bains, France (27 Apr 1988).

The current status of the experimental search for neutrino mass is reviewed, with emphasis on direct kinematic methods, such as the beta decay of tritium. The situation concerning the electron neutrino mass as measured in tritium beta decay is essentially unchanged from a year ago, although a great deal of experimental work is in progress. The ITEP group continues to find evidence for a nonzero mass, now slightly revised to 26(5) eV. After correcting for recently discovered errors in the energy loss distribution and source thickness, however, the Z{umlt u}rich group still claims and upper limit of 18 eV. There may be evidence for neutrino mass and mixing in the SN1987a data, in the same range suggested by the ITEP experiment. 42 refs., 3 figs.

52553 **(LA-UR—88-2609) Review of neutrino mass measurements.** Robertson, R.G.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 18p. (CONF-8806204—2). NTIS, PC A03/MF A01. Order Number DE88016339/JAW.

From 13. international conference on neutrino physics and astrophysics; Boston, MA, USA (5 Jun 1988).

The current status of the experimental search for neutrino mass is reviewed, with emphasis on direct kinematic methods. New data on the {tau} neutrino from the Argus collaboration have reduced the upper mass limit a factor of 2. The situation concerning the electron neutrino mass as measured in tritium beta decay is essentially unchanged from a year ago. Simpson and Hime report finding evidence for a 17-keV neutrino in the β decay of ^{35}S. There may be evidence for neutrino mass and mixing in the SN1987a data. 62 refs., 4 figs.

52554 **(LBL—25433) Resonances in photon-photon scattering.** Chanowitz, M.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 26p. (CONF-8804147—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016641/JAW.

From 8. international workshop on photon-photon collisions; Shoresh, Israel (24 Apr 1988).

Selected topics in meson spectroscoy are reviewed as they are illuminated by photon-photon collisons. Subjects include the S^*/f_0 (975) and δ/a_0 (980) as {ovr qq}qq candidates, the {iota}/{eta} (1460) and θ/f_2 (1700) as glueball candidates, and the spin 1 X(1420) seen in tagged events which represents new physics whether its parity is positive, J/sup PC/ = 1^{++}, or negative with exotic J/sup PC/ = 1/sup {minus}+/. 57 refs., 2 figs., 1 tab.

52555 **(LBL—25652) Inclusive production of vector mesons in e^+e/sup minus/ annihilation at $\sqrt{s}$ = 29 GeV.** Edberg, T.K. (Lawrence Berkeley Lab., CA (USA)). 1 Aug 1988. Contract AC03-76SF00098. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88016660/JAW.

This thesis describes the measurement of multiplicities and differential cross-sections of the {rho}^{0}, K^{*0}, and {phi} in e^+e^- annihilation at $\sqrt{s}$ = 29 GeV, using data collected by the TPC/2γ Detector Facility at PEP. The number of vector mesons per event is determined to be N({rho}^{0}) = 0.77 +- 0.08 +- 0.15, N(K^{*0} + {bar K}^{*0}) = 0.58 +- 0.05 +- 0.11, and N({phi}) = 0.076 +- 0.010 +- 0.012. These multiplicities are used to find that the ratio of strange quarks to up quarks produced in the hadronization process is 0.30 +- 0.07, and that the ratio of light vector mesons to all light mesons produced in the hadronization process is 0.45 +- 0.08. All results agree with previous measurements. Measurements are compared with predictions of the Lund and Webber hadronization models, neither model is particularly favored nor disfavored. 60 refs., 32 figs., 24 tabs.

52556 **(LBL—25660) Electron pair production in p + Be and Ca + Ca collisions at the Bevalac.** Naudet, C.; Carroll, J.; Gordon, J.; Hallman, T.; Igo, G.; Kirk, P.; Krebs, G.F.; Lallier, E.; Landaud, G.; Letessier, A. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 6p. (CONF-880758—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016640/JAW.

From Workshop on nuclear and particle physics on the light cone; Los Alamos, NM, USA (18 Jul 1988).

We report on the measurements of direct electron pair production in p-Be interactions at 1.0, 2.1 and 4.9 GeV and Ca + Ca at 1.0 and 2.0 GeV/A. The distributions of invariant mass and p/sub t/ are presented along with the total cross section. We observe a structure in the invariant mass spectra at approximately 275 MeV for 2.0 and 4.9 GeV p + Be data. A rapid decrease in the p + Be total cross-section is observed between 2.1 and 1.0 GeV. Both observations are consistent with the interpretation that pion-pion annihilations dominate production mechanism. 10 refs., 3 figs., 1 tab.

52557 **(MPI-PAE/Exp.El.—152) Study of the production of charm mesons in π/sup -/-beryllium interactions at 200 GeV/c.** Neugebauer, E. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik). Jun 1985. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754352/JAW.

The results presented in this thesis are from research done at the Max-Planck-Institut fuer Physik in Munich. They are based on data of the NA11 experiment that was performed by the ACCMOR Collaboration at the CERN SPS. The completely reconstructed D mesons are the basic input for the determination of partial and total cross sections of D production in π/sup -/-beryllium interactions. The total cross section for the production of Danti D pairs amounts to (28+-5+-14)μb/nucleon. The total cross section for F/sup +-/ production is given by σ(F/sup +-/).B(F/sup +-/ -> K/sup +/ K/sup -/π/sup +-/) = (0.4+-0.5+-0.2)μb/nucleon, where B(F/sup +-/ -> K/sup +/K/sup -/π/sup +-/) denotes the not yet measured branching ratio. (orig./HSI).

52558 **(SLAC-PUB—4671) A search for the decay $D^0 \rightarrow$ {bar K}$^0e^+e^-$.** Adler, J.; Becker, J.J.; Blaylock, G.T.; Bolton, T.; Brient, J.C.; Brown, J.S.; Bunnell, K.O.; Burchell, M.; Burnett, T.H.; Cassell, R.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050. 10p. (CONF-880867—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016999/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

A search for the decay of the charmed neutral D-mesons $D^0 \rightarrow$ {bar K}$^0e^+e^-$ is presented, based on data collected at the {psi}(3770) resonance with the Mark III detector at SPEAR. The search does not show any evidence for the occurrence of this process, leading to an upper limit on the decay branching ratio of 1.7 {center←dot} 10^{-3} at the 90% confidence level. No other results on this decay channel have been reported so far. 10 refs., 1 fig.

52559 **Physics at higher energies and smaller distances: Are there limits?.** Panofsky, W.K.H. (Stanford Linear Accelerator Center, Stanford, California 94305). *AIP (American Institute of Physics) Conference Proceedings;* **169**: No. 1, 6-21(20 Sep 1988). (CONF-8710320—).

From Modern physics in America: a Michelson-Morley centennial symposium; Cleveland, OH, USA (30 Oct 1987).

Recent progress in high energy physics has linked our increased understanding of physics at the smallest distances with the physics of the cosmos. The limits of physics at higher energies is discussed from the standpoint of the limits of the machines used to produce charged particle beams and interactions at such energies./aip/.

52560 Observation of psi production in e^+e^- annihilation at 29 GeV. Wormser, G.; Ong, R.A.; Abrams, G.; Amidei, D.; Baden, A.R.; Barklow, T.; Boyarski, A.M.; Boyer, J.; Burchat, P.R.; Burke, D.L.; and others. (Stanford Linear Accelerator Center, Stanford University, Stanford,). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 1001-1003(1 Aug 1988).

Inclusive psi production in e^+e^- annihilation at 29 GeV has been measured with the Mark II detector. The psi cross section is found to be 1.1 +- 0.5 +- 0.4 pb. After subtraction of the expected contribution from B decay, an upper limit of 0.02σ/sub μ//sub μ/ is obtained for other sources of psi production.

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REFER ALSO TO CITATION(S) 52479, 52550, 52603, 52604, 52607, 52690, 52694, 52696, 52697, 52698, 52704

52561 (BONN-HE—88-04) Leptonic decay constant f/sub B/ of the B(banti d) meson and the beauty quark mass. Reinders, L.J. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Feb 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754305/JAW.

We determine the value of the beauty quark mass using the existing detailed experimental information in moment and Borel transformed sum rules for the vector b-quark current anti bγ/sub μ/b. The resulting value (m/sub b/ = 4.17+-0.02 GeV) is used for calculating the decay constant f/sub B/ and the mass of the B meson via two sum rules, one constructed from the correlation function of two pseudoscalar currents and the other from the correlation function of a pseudoscalar and an axial vector current. We find f/sub B/ = 170+-20 MeV.

52562 (CONF-8806203—1) Where next in polarized leptoproduction?. Close, F.E. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015546/JAW.

From Symposium on future polarization at Fermilab; Batavia, IL, USA (13 Jun 1988).

The implications of the EMC polarized structure function $g_1(x,Q^2)$ will be summarized under three headings: (1) the integrand, (2) what insights future high-energy beams may bring, and (3) the integral. 10 refs., 1 fig.

52563 (CONF-8806204—1) The parton distributions in nuclei and in polarized nucleons. Close, F.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015545/JAW.

From 13. international conference on neutrino physics and astrophysics; Boston, MA, USA (5 Jun 1988).

The emerging information was reviewed on the way quark and anti-quark, and gluon distributions are modified in nuclei relative to free nucleons. Some implications of the recent data on polarized leptoproduction are discussed. 27 refs., 6 figs.

52564 (INIS-SU—9/A, pp 165-176) On different approach to parity nonconservation in low-energy p-barp scattering. Dubovik, V.M.; Obukhovskij, I.T. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

Technology of calculating p-vector p scattering asymmetry using potential and quark-nuclear approach to parity nonconservation is presented in brief. Unification of quark-nuclear approach in composite quark bag model is carried out. Quark approach to the problem of NN-interaction in core region permits to give a new interpretation to infinite repulsion at small distances.

52565 (INS—673) Renormalization group analysis of quantum chromodynamics at finite temperature. Yamada, Hirofumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1988. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754552/JAW.

We re-investigate the behaviour of the effective coupling constant using the gauge invariant Wilson loop in Minkowsky space-time. The result tells us that the interaction of static q-q-bar pair becomes weak at high temperatures and at large distances.

52566 (IPNO-TH—87-85) Generalized Fayet-Sohnius hypermultiplet. Delamotte, B.; Ouvry, S. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies; Paris-11 Univ., 91 - Orsay (France)). Dec 1987. 10p. (In French). (LPTHE—87-58). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754953/JAW.

We present a N=2 harmonic superspace formulation for massless supermultiplets of the type (s-1/2, s, s+1/2) where s is any integer, that generalize the Fayet-Sohnius matter hypermultiplet.

52567 (ITEF—65(1987)) On the second-class currents in the tau-lepton decays. Lobov, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703292/JAW.

The recent experimental data on second-class hadron currents in tau -> $\omega\pi\nu$ and tau -> eta$\pi\nu$ decays are discussed. On the basis of the formalism of current algebra and soft-pion technique, the probabilities of these decays are calculated. Different field theories provided for second-class current construction are discussed. 10 refs.; 1 fig.

52568 (ITEP—80(1987)) Weak non-leptonic decays of charmed mesons. Addendum. Blok, B.Yu.; Shifman, M.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703317/JAW.

An error in previous work of these authors is eliminated and the prediction for Γ(D/sub S/ -> pπ) within the QCD sum rule approach is discussed. 4 refs.; 1 fig.

52569 (ITP—86-157) Quark and hadron components in Regge trajectories. Glushko, N.I.; Kobylinskij, N.A.; Tutik, R.S.; Shelest, V.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703326/JAW.

All the data on vector and tensor Regge trajectories are analysed on the basis of right-hand analyticity and dual topological unitarization. The trajectory components generated by regeon coupling with quark and hadron sectors are separated. It is shown that the trajectory degeneracy and the state purity present at planar quark level become then broken through reggeon instability, i.e. reggeon coupling with hadronic channels. A nonlinearity is found to be essential at planar level; with the neglect of this effect impossible to agree with the data on resonances region and that on scattering. 28 refs.; 7 figs.; 4 tabs.

52570 (JINR—D-1,2-86-668, pp 72-83) Gluon distributions in the small x-limit. Kwiecinski, J. (Institute of Nuclear Physics, Krakow (Poland)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The prupose of this paper is to report the recent results concerning fairly detailed quantitative analysis of gluon distributions in the region of small x (10/sup -4/ <or approx. x <or approx. 10/sup -2/) and large Q/sup 2/ (Q/sup 2/ >or approx. 10 GeV/sup 2/) which is relevant for gluon jet production up to the TeV energy region and which goes beyond the leading logQ/sup 2/ approximation. This analysis includes the following "corrections" to the leading logQ/sup 2/ approximation: the screening corrections and the "corrections" which come from treating the powers of logQ/sup 2/ and of log1/x on the same footing. 13 refs.; 6 figs.

52571 (JINR—D-1,2-86-668, pp 105-113) **Hadron-hadron interactions (NN, πN, $\pi\pi$, πK, KN) in the composite quark bag model.** Grach, I.L.; Kalashnikova, Yu.S.; Narodetskij, I.M.; Simonov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

On the basis of P-matrix analysis and the model of composite quark bags (CQB) the NN-, PIN-, PIPI-, PIK-, KN-interactions are considered. Fitting of experimental P-matrix by theoretical expressions suggested, which permit to avoid nonphysical properties of resulting P- and S-matrices, is carried out. For all the interactions studied a series of CQB potentials is considered and parameters of NN-, PIN-, PIPI-, PIK-, KN-interactions and dibaryon resonances, presented as tables, are determined. Results obtained in CQB are compared with calculation results in the model of primitives and their agreement is demonstrated. 9 refs.; 2 tabs.

52572 (JINR—D-1,2-86-668, pp 134-147) **Diquarks.** Fredriksson, S. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Theoretical Physics). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

In the framework of diquark Stockholm model certain effects in the following processes are analyzed: rescattering in hadron-deuteron reactions; formation of nuclear matter, consisting only of diquarks in heavy ion collisions; deep inelastic lepton-nucleon scattering, deep inelastic lepton-nucleus scattering and EMC effect; production of protons with large transverse momenta in hadron-proton reactions; formation of diquark plasma in heavy ion reactions; electron-positron annihilation into hadrons . In the model suggested the structure of diquark states in nucleons is considered, the difference between structure functions of proton F/sup p/ and neutron F/sup n/ is determined. Data on SLAC and EMC are compared, which are presented in graphic form and show the dependence of the difference between F/sup p/-F/sup n/ structure functions and F/sup n//F/sup p/ ratio on the scale variable x. The possibility of existence of bound diquark states forming quark matter is discussed. 36 refs.

52573 (JINR—D-1,2-86-668, pp 169-177) **Quark models of multiproduction off nuclear targets.** Levchenko, B.B.; Nikolaev, N.N. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; AN SSSR, Chernogolovka. Inst. Teoreticheskoj Fiziki). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

A subject of this talk is a review of principal predictions of the quark model, with particular emphasis on the intranuclear interactions and the nucleus responce. Some novel applications of the model to the deep inelastic leptoproduction of nuclei, the process best tailored to test the formation length concept, are reported. Numerical calculations are based on the Monte Carlo code which produces exclusive final states, which can be subjected to precisely the same cuts as applied experimentally. An important ingredient is the multi-nucleon short-range correlation mechanism of the cumulative proton production, which contributes significantly in the forward hemisphere too. The constituent quark model supplemented by the formation length formalism, does remarkable well in the hadron-nucleus and lepton-nucleus collisions. The fragmentation of nucleus can only be understood as a quantitative level at an expense of significant cascading, which accounts for 30-40% of the suplus multiplicity. That is particularly evident in the lepton-nucleus interactions. None of the numerous models where this cascading is ignored can be regarded as credible. 13 refs.; 11 figs.

52574 (JINR—D-1,2-86-668, pp 178-185) **Description of the particle production in pion-nucleus collisions by the additive quark model.** Holynski, R.; Jezabek, M.; Wozniak, K. (Institute of Nuclear Physics, Krakow (Poland)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

In this paper the analysis of experimental data for pion-nucleus interactions in the energy range 60 GeV - 300 GeV is presented The aim of this analysis is to test whether the particle densities in projectile fragmentation region can be adequately described by additive quark model. To do this it was necessary to find the relation between the average number of wounded quarks in the projectile and the number of fast protons emitted from struck nucleus. After deriving this relation it was possible to extract from the experimental π/sup -/-emulsion data the fragmentation functions for both wounded and spectator quarks. It is concluded that taking the advantage of the relation between the number of collisions of the projectile inside the nucleus and the number of emitted fast protons from the struck target nucleus it is possible in the framework of the additive quark model to calculate the average number w-bar of wounded quarks as the function of gray track producing particles N/sub g/. Using the w-bar and N/sub g/ dependence the fragmentation functions of wounded and spectator quarks can be extracted from π/sup -/-emulsion data. The fragmentation functions derived from π/sup -/-emulsion data adequately describe the results from π/sup -/-proton experiment. 9 refs.; 4 figs.; 1 tab.

52575 (JINR—D-1,2-86-668, pp 186-195) **Unified physical picture of hadron-hadron and e/sup +/e/sup -/ collisions.** Chou, T.T. (Georgia Univ., Athens (USA). Dept. of Physics). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

This report consists of a summary of some published work on multiparticle production in hadron-hadron and e/sup +/e/sup -/ collisions. Essential physical ideas in the geometrical model of multiparticles poduction in hadron-hadron collisions are reviewed, which lead to a simple description of the single-particle spectrum. These ideas are then applied to two-jet events in e/sup +/e/sup -/ annihilations. A unified physical picture for both collisions emerges which is compared with experimental data. A number of predictions are made including the prediction that KNO scaling does not obtain for e/sup +/e/sup -/ two-jet events. 18 refs.; 5 figs.

52576 (JINR—D-1,2-86-668, pp 196-203) **Statistical model for multiparticle production in hadron-hadron interactions.** Mueller, H.; Barz, H.W.; Schulz, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

A model is presented which is based to a large extent on the pure statistical features of mutiparticle production processes. It is an improved and generalized version of the cluster excitation model which has originally been developed to describe cumulative particle production in hadron-nucleus interactions. Application of the model the multiparticle production in proton-proton interactions at 100 GeV/c and 175 GeV/c (corresponding to the c.m. energies of $\sqrt{s}$ = 13.8 GeV and 18.2 GeV) is calculated and compared with data. To demonstrate in which region of energy the model seems to be applicable some calculations have been done to describe data measured at 800 MeV kinetic incidence energy ($\sqrt{}$ = 2.24 GeV) and at $\sqrt{s}$ = 62.2 GeV. A phase space model for two subsystems the phase spaces of which are restricted by exponentially descreasing energy distributions have been developed. This model is able to describe multiparticle production processes in a large energy interval without any input from other reactions. 7 refs.; 8 figs.

52577 (JINR—D-1,2-86-668, pp 94-99) **Narrow diproton resonances in the np -> ppπ/sup -/ reaction at P/sub n/ =1.257 GeV/c and the model of rotating joint oriented strings.** Troyan, Yu.A.; Nikitin, A.V.; Pechenov, V.N.; Moroz, V.I.; Ierusalimov, A.P.; Stel'makh, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

To search narrow diproton resonances in the np->ppπ/sup -/ reaction at P/sub n/=1.257 GeV/c the spectra of effective masses of two protons are studied. The distribution of effective mass of two protons from the above reaction forecasted by the model of ratating joint oriented rings is performed.The expression for the mass spectra of a six-quark system is obtained. The dependence of pp-scattering cross section on kinetic energy of incident protons is shown. The conclusion is made that peaks observed experimentally in the effective mass distributions can be interpreted as six-quark resonances with small widths. 18 refs.; 3 figs.; 2 tabs.

52578 (JINR—D-1,2-86-668, pp 100-104) **Multiquark resonances and bag model.** Kondratyuk, L.A.; Krivoruchenko, M.I.; Martem'yanov, B.V.; Shchepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

To describe multiquark baryon resonances in a quark bag model 3q, 6q states of quark matter are considered. State dilambda instability of a strange quark matter and mass dibaryon spectra are discussed. 6q resonances are considered as stretched ratating bags. Masses and levels of dibaryon states of different configurations are presented. 23 refs.; 1 fig.; 1 tab.

52579 (JINR—D-1,2-86-668, pp 114-118) **Masses and widths of the exotic baryons with negative parity.** Kulish, Yu.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Masses and widths of the exotic baryons with J/sup P/=3/2/sup -/ in the model including 4 QQ-bar, DP- and DV-state mixing (D corresponds to decuplet, and P and V-octet of SU(3,F) flavor group) are considered in the paper. As far as the exotic baryons with minimal masses have been studied, then consideration of 4 QQ-bar-systems with quarks in the ground state is natural. Then mesons and baryons in DP- and DV-systems are to have a zero relative orbital momentum. Six baryons with negative parity: two - with J/sup P/=1/2/sup -/ and three - with J/sup P/=3/2/sup -/ and one - with J/sup P/=5/2/sup -/, are predicted in the model with 4 QQ-bar-, DP- and DV-state mixing for any physical state with I and S definite values. It permits to ibtain values of physical state masses similar to those observed in the experiment. To identify predicted and observed baryons, it is necessary to have information about spins and parities in the exotic baryon resonances. 21 refs.; 1 tab.

52580 (JINR—D-1,2-86-668, pp 204-213) **Quark-hadron phase transformation in relativistic hydrodynamics.** Gorenshtejn, M.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The paper is devoted to certain problems on the shock wave (SW) theory in relativistic hydrodynamics and to the problem on phase transformation from the quark-gluon plasma state to hadron gas. Quark-hadron transformation, if it takes really place as a strong hydrodynamic breaking, is a SW "deflagration". According to the theory of nonrelativistic SW, "deflagrations" are possible only in the matter with anomalous properties, at least, for certain values of thermodynamic parameters. The condition determining standard and anomalous matters in relativistic hydrodynamics, as well as stability criterion for relativistic SW is found. The results obtained will be used to analyze the possibilities of quark-hadron phase transformation as SW in a bag model and lattice quantum chromodynamic. 11 refs.; 7 figs.

52581 (JINR—D-1,2-86-668, pp 226-235) **Antiquark and antinucleon condensates in nuclear reactions.** Slobodrian, R.J. (Laval Univ., Quebec City (Canada). Dept. de Physique). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

A model-independent approach is used to investigate mechanisms of production of antiquark and antinucleon condensates in reactions /sup 11/B+/sup 4/He->/sup 14/O+p-bar,/sup 11/B+/sup 4/Me->/sup 14/N+n-bar, /sup 11/B+/sup 4/He->/sup 14/O+p-bar+2ν/sub B/, /sup 11/B+/sup 4/He->/sup 14/N+n-bar+2ν/sub B/, where ν/sub B/ is a baryon neutrino. Unified theories applied to the description of quark-gluon plasma formation and antinucleon production in nuclear reactions and nucleon decay are discussed. The problem of emission of baryon neutrino (baryophore) and nucleon-antinucleon transitions is considered. 17 refs.; 4 figs.

52582 (JINR—E-2-87-522) **On the spectrum of radial excitations of the rho - and ω - mesons and a possible existence of rho/sub g/ - and ω/sub g/ - hybrides.** Govorkov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703349/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

On the basis of vector meson dominance (VMD) the joint analysis of new experimental data concerning e/sup +/e/sup -/ -> ωPI/sup 0/, PI/sup +/PI/sup -/PI/sup 0/ reactions and TAU -> NU/sub (sub t)auΩ/PI decay is made. It is shown that their most consistent description is obtained in the assumption of the existence of three resonances of approximately 1425, 1625 an d 1750 MeV. Their total widths and widths of leptonic decays per e/sup +/e/sup -/-pair are evaluated. It follows from the evaluati ons that none of the resonances can be the orbital D-state. Interpretation of the resonances as radial excitations /1425 / and /1750/ of rho- or ω-mesons and qq-barg-hybride /1625/ state is discussed. 21 refs.; 3 figs.; 4 tabs.

52583 (KFKI—1988-19/A) **Inclusive production of the γ/sup -/ particles in 280 GeV/c muon-proton interactions.** Hidas, P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Apr 1988. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704160/JAW.

An average number of the Xi-minus particles per deep inelastic event in 280 GeV/c muon-proton interactions is calculated on the basis of the NA9 data of the European Muon Collaboration. The Xi-minus is the lowest mass particle of strangeness 2, decays of which is convenient to observe, thus it can be used to check predictions of various theoretical models. The observed average number of Xi-minus particles is below 1.78x10/sup -3/, which matches to the prediction of Lund model and to the results of other experiments. (D.Gy.) 14 refs.; 4 figs.

52584 (LA-UR—88-2658) **Physics with thermal antiprotons.** Hynes, M.V.; Campbell, L.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-8805142—25). NTIS, PC A02/MF A01. Order Number DE88016330/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

The same beam cooling techniques that have allowed for high luminosity antiproton experiments at high energy also provide the opportunity for experiments at ultra-low energy. Through a series of deceleration stages, antiprotons collected and cooled at the peak momentum for production can by made available at thermal or sub-thermal energies. In particular, the CERN, PS-200 collabo-

ration is developing an RFO-plused ion trap beam line for the antiproton gravitational mass experiment at LEAR that will provide beams of antiprotons in the energy range 0.001--1000.0 eV. Antiprotons at these energies make these fundamentals particles available for experiments in condensed matter and atomic physics. The recent speculation that antiprotons may form metastable states in some forms of normal matter could open many new avenues of basic and applied research. 7 refs., 3 figs.

52585 **(LBL—25380) Neutrino mass.** Kayser, B. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 6p. (CONF-8805142—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016650/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

An introduction is given to the search for evidence of neutrino mass. 10 refs.

52586 **(PITHA—88/04) 4-jet events in e/sup +/e/sup -/ annihilation: Testing the 3-gluon vertex.** Bengtsson, M.; Zerwas, P.M. (Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Theoretische Physik). (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). Mar 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754354/JAW.

The distribution of the azimuthal angle between the planes formed by the 2 highest energy jets and the 2 lowest energy jets in 4-jet events of e/sup +/e/sup -/ annihilation, depends characteristically on the triple-gluon vertex.

52587 **(PITHA—88/12) Finding the 3-gluon vertex from 4-jet events in e/sup +/e/sup -/ annihilation.** Bengtsson, M. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Theoretische Physik A und Inst. fuer Theoretische Physik). (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.; Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Theoretische Physik und Inst. fuer Theoretische Physik). May 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754356/JAW.

Although the 3-gluon coupling is a necessary ingredient for QCD to be asymptotically free, conclusive experimental evidence is still lacking. We make here a comprehensive and systematic study of the possibilities of finding it in e/sup +/e/sup -/ annihilation at the Z/sup 0/ resonance. Emphasis is put on observables of 4-jet events which are sensitive to the specific helicity structure of the processes g -> gg and g -> qanti q. These observables give a quantitative and qualitative difference between QCD and abelian models, making it straightforward to confirm the nonabelian nature of the theory of strong interactions.

52588 **(PITHA—88/13) PYTHON - the Monte Carlo for deep inelastic leptoproduction. Short write up.** Bengtsson, M. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Theoretische Physik A und Inst. fuer Theoretische Physik). (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.; Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Theoretische Physik und Inst. fuer Theoretische Physik). May 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754357/JAW.

As its name indicates, this is a relative to the Lund Monte Carlo for hadronic interactions - PYTHIA. It performs parton shower evolution in deep inelastic scattering which results in a complete event on the partonic level. Subsequent fragmentation into hadrons may be done using the Lund string fragmentation scheme. The basic hard interaction processes, neutral and charged currents, are included together with a theoretically well developed scheme for parton showers where the first order QCD matrix element is used as a guideline for hard emission.

52589 **(SLAC-PUB—4672) Why the proton spin is not due to quarks.** Karliner, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1988. Contract AC03-76SF00515. 9p. (CONF-8806203—2; CONF-8805142—26). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015921/JAW.

From Symposium on future polarization at Fermilab; Batavia, IL, USA (13 Jun 1988).

Recent EMC data on the spin-dependent proton structure function suggest that very little of the proton spin is due to the helicity of the quarks inside it. We argue that, at leading order in the 1/N/sub c/ expansion, none of the proton spin would be carried by quarks in the chiral limit where m/sub q/ = 0. This model-independent result is based on a physical picture of the nucleon as a soliton solution of the effective chiral Lagrangian of large-N/sub c/ QCD. The Skyrme model is then used to estimate quark contribution to the proton spin when chiral symmetry and flavor SU(3) are broken: this contribution turns out to be small, as suggested by the EMC. Next, we discuss the other possible contributions to the proton helicity in the infinite-momentum frame---polarized gluons (ΔG), and orbital angular momentum (L/sub z/). We argue on general grounds and by explicit example the $\Delta G = 0$ and that if the parameters of the chiral Lagrangian are adjusted so that gluons carry {approximately}50% of the proton momentum, most of the orbital angular momentum L/sub z/ is carried by quarks. We mention several experiments to test the EMC results and their interpretation. 43 refs., 3 figs.

52590 **General-relativistic radiation hydrodynamics and neutrino transport in polar-sliced space-time.** Schinder, P.J. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1673-1683(15 Sep 1988).

Extending the work of Schinder, Bludman, and Piran, I derive the equations of radiation hydrodynamics in polar-sliced space-time. The additional terms which describe the effects of neutrino stress energy on the gas dynamics are added to the equations of hydrodynamics. The neutrino Boltzmann equation and its lowest angular and energy moments are derived in comoving coordinates with neutrino energies and directions determined in comoving frames. It is shown that the Boltzmann equation gives the correct results when neutrinos are strongly trapped, and the neutrinos become just another component of a perfect gas. Techniques which I plan to use to numerically solve the neutrino transport equations are discussed.

52591 **Baryogenesis from a Chern-Simons condensate.** Enqvist, K.; Nanopoulos, D.V.; Rao, S. (Physics Department, University of Wisconsin-Madison, Madison, Wisconsin 53705). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1797-1801(15 Sep 1988).

We study a new mechanism of baryon asymmetry generation at the electroweak scale proposed by Shaposhnikov. We give an alternative derivation of the effective action in the presence of background fermion density by showing that the gauge current becomes anomalous in a finite-chemical-potential background. We distinguish between the (physically irrelevant) change in the Chern-Simons number due to large gauge transformations and the (physically relevant) change in it due to a finite chemical potential. At high temperatures, ΔB created by tunneling between gauge-invariant vacua can be stored as a Chern-Simons condensate. At the phase transition, this state becomes unstable, but naively it decays to (a gauge transform of) the trivial vacuum with the same Chern-Simons number and hence no baryons are produced.

52592 **Doubly Okubo-Zweig-Iizuka-rule--violating effects in J/psi decays.** Seiden, A.; Sadrozinski, H.F.; Haber, H.E. (Santa Cruz Institute for Particle Physics, University of California, Santa Cruz, California 95064). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 824-836(1 Aug 1988).

We analyze some of the existing data available for the hadronic and radiative production of mesons from the J/psi. A reanalysis of the decays into a pseudoscalar- and vector-meson pair indicates good agreement with the pseudoscalar mixing angle derived

from the new two-photon widths of these mesons. An important ingredient is the inclusion of the doubly disconnected diagram, which also provides a natural mechanism for decays into a meson plus gluonium. We attempt to estimate the decay rate of J/psi into gluonium and mesons using the radiative decay widths as input. We also present a discussion of J/psi decays into tensor+vector and axial-vector+vector states.

52593 **Lepton-number violation and massless nonorthogonal neutrinos.** Langacker, P.; London, D. (Deutsches Elektronen Synchrotron--DESY, Hamburg, Federal Republic of Germany). *Physical Review [Section] D: Particles and Fields;* **38**: No. 3, 907-916(1 Aug 1988).

Mixing between light and heavy neutrinos can induce lepton-flavor and total-lepton-number violation in the light sector, even if the light neutrino masses are zero or extremely small, because the states actually produced in weak processes are generally nonorthogonal. We develop the formalism for describing such nonorthogonal neutrinos and explore the phenomenological implications for neutrino "oscillation" experiments, the solar-neutrino problem, constraints from universality and other charged- and neutral-current experiments, $\mu \to e\gamma$, and $\Delta L = +- 2$ effects in muon decay and neutrinoless double-beta decay.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 52479, 52592, 52593, 52604, 52606

52594 **Zero modes and anomalies in superconducting strings.** Widrow, L.M. (Department of Physics, Enrico Fermi Institute, The University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1684-1700(15 Sep 1988).

Superconductivity in cosmic strings occurs when electrically charged fermions are trapped as massless particles (Jackiw-Rossi zero modes) in the core of a string. Currents are generated when an electric field is applied along the string, or more realistically, when the string moves through a cosmic magnetic field. In realistic models (e.g., those inspired by grand unified theories), the fermion-vortex systems that arise can be quite complicated and the question of whether or not superconductivity occurs is very model dependent. For example, in certain models, mixing between right- and left-moving zero modes gives rise to an effective mass for the fermions on the string. The currents in this case, at least for reasonable values for cosmic magnetic fields, are uninterestingly small. In this paper, we present a simple method for determining the number of true zero modes in a special class of fermion-vortex systems. These results are then applied to a particular particle-physics model based on the gauge group E_6. We also consider the possibility that summation/sub left movers/q^2not =summation/sub right movers/q^2 where q is the electromagnetic charge of a zero mode. In this situation, which occurs in "frustrated" as well as global strings, there is a gauge anomaly (and therefore charge nonconservation) in the effective (1+1)-dimensional theory for the fermion-string system. In the presence of an electric field, the string acquires both charge and current. Charge nonconservation on the string is accounted for by an inflow of charge from the world outside the string. However, both charge and current can be screened, either by polarization of the vacuum or by the surrounding plasma.

52595 **Global gauge anomaly and James numbers of Stiefel manifolds.** Zhang, H.; Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1880-1887(15 Sep 1988).

The global anomaly coefficient of locally anomaly-free representations of simple Lie groups is intimately connected with the James number of Stiefel manifolds via some exact short homotopic sequences. We will prove some propositions concerning this problem and apply them for calculations of global anomalies of simple Lie groups in even dimensions.

52596 **$b \to s\gamma$ in superstring inspired models.** Dreiner, H. (Physics Dept., Univ. of Wisconsin-Madison, Madison, WI (US)). *Modern Physics Letters B;* **3**: No. 9, 867-876(Aug 1988).

Superstring inspired models contain, in general, extra quarks per family beyond those of the standard model. These quarks may give considerable contributions to $b \to s\gamma$. Limits on their masses and couplings may be extracted from the presently available upper limits on this rare decay.

52597 **Observation of +- F/sub 0/ symmetry in F-spin multiplets.** Jain, A.K.; Casten, R.F. (Univ. of Roorkee, Roorkee (IN)). *Modern Physics Letters B;* **3**: No. 8, 743-748(Jul 1988).

Pairs of conjugate nuclei with the same F-spin and +-F/sub 0/ values also have identical N/sub rho/N/sub n/ values. In the rare earth region, these +-F/sub 0/ pairs are symmetrically located with respect to the F/sub 0/ = 0, A = 164 isobar and their empirical excitation energy spectra are found to be very similar. An IBM-2 Hamiltonian with constant parameters has such a built-in symmetry and can explain the general trends except for the 2/sup +//sub γ/ bandhead energies.

52598 **Improved surface impedance methods for 2-D and 3-D problems.** Deeley, E.M.; Xiang, J. (Dept. of Electronic and Electrical Engineering, King's College London (KQC), Strand, London (GB)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **24**: No. 1, 209-217(Jan 1988).

The surface impedance method is improved for 2-D and 3-D problems by using more accurate values of impedance based on the spatial variation of fields on the surface of conducting regions. This enables problems to be solved by computing only scalar magnetic potential in air regions. The method has also been extended to thin and to curved media, and the requirements for matrix symmetry are described. The method has been applied to two test problems, giving solutions which are about 6% and 4% in error respectively.

6454 Field Theory

REFER ALSO TO CITATION(S) 51831, 52479, 52480, 52592, 52594, 52731, 52794, 52808

52599 **(BNL—41502) String models for ultrarelativistic heavy ion collisions: Lund model versus color exchange models.** Werner, K. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-8805142—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015856/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

We discuss similarities and differences between several string models for ultrarelativistic nucleus nucleus scattering, being proposed to account for "normal" collisions (with no quark gluon plasma involved). 9 refs., 2 figs.

52600 **(LBL—25278) Low-energy structure of four-dimensional superstrings.** Zwirner, F. (Lawrence Berkeley Lab., CA (USA)). May 1988. Contract AC03-76SF00098. 9p. (UCB-PTH—88/12; CONF-8803109—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016648/JAW.

From 23. Rencontre de Moriond conference: electroweak interactions and unified theories; Les Arcs, France (6 Mar 1988).

The N = 1, d = 4 supergravity theories derived as the low-energy limit of four-dimensional superstrings are discussed, focusing on the properties of their effective potentials. Gauge symmetry breaking is possible along several flat directions. A class of superpotential modifications is introduced, which describes supersymmetry breaking with vanishing cosmological constant and Str M^2 = 0 at any minimum of the tree level potential. Under more restrictive assumptions, there are minima with broken supersymmetry at which also Str $f(M^2) = 0$ for any function f, so that the whole one-loop cosmological constant vanishes. This result is interpreted in terms of a new discrete boson-fermion symmetry, relating particles whose helicities differ by 3/2, e.g., the graviton and the 'dilatino.' 21 refs.

52601 **String perturbation theory.** Baker G.A. Jr. (Los Alamos National Laboratory, Mail Stop B262, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 13, 1516-1516(26 Sep 1988).

A Comment on the Letter by D. J. Gross and V. Periwal, Phys. Rev. Lett. 60, 2105 (1988).

52602 **Pisarski replies.** Pisarski, R. (Fermilab, P.O. Box 500, Batavia, Illinois 60510). *Physical Review Letters;* **61**: No. 12, 1430-1430(19 Sep 1988).

Pisarski replies to comment by F. David [Phys. Rev. Lett. 61, 1429 (1988)].

52603 **Tachyons and perturbative unitarity.** Jacobson, T.; Tsamis, N.C.; Woodard, R.P. (Department of Physics, Brandeis University, Waltham, Massachusetts 02254). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1823-1834(15 Sep 1988).

The Cutkosky rules are generalized to include tachyons. A consequence is that Lorentz-invariant interacting theories which possess tachyons cannot obey even the weakest possible form of unitarity beyond the tree level. The problem (although not the cutting rules) is shown to extend to bosonic string theory. Thus unitarity cannot be used to determine the range of modular integration in bosonic string loop amplitudes.

52604 **New approach to one-loop calculations in gauge theories.** Bern, Z.; Kosower, D.A. (Niels Bohr Institute, Blegdamsvej 17, DK-2100 Copenhagen Oe, Denmark). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1888-1892(15 Sep 1988).

We propose using the technology of four-dimensional string theories to calculate amplitudes in gauge theories. Strings make such calculations much more efficient by summing a large number of Feynman diagrams all at once. We check the idea by constructing a string model reducing to a pure non-Abelian gauge theory in the infinite-tension limit and computing its β function with these techniques.

52605 **Chiral-symmetry breaking in dual QCD.** Baker, M.; Ball, J.S.; Zachariasen, F. (Department of Physics, University of Washington, Seattle, Washington 98195). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1926-1933(15 Sep 1988).

In the context of the formulation of QCD with dual potentials, we show that chiral-symmetry breaking occurs only in the confined state. Therefore, the transition temperature, beyond which chiral symmetry is restored, is the same as the deconfinement temperature. To carry out the calculation, it is necessary to couple quarks to dual gluons. We indicate how this is done (to lowest order in the magnetic coupling constant) and give the Feynman rules for quark—dual-gluon vertices.

52606 **From baglike models to the large-N/sub c/ limit via the Abelian projection.** Rosenzweig, C. (Syracuse University, Syracuse, New York, 13244-1130). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1934-1936(15 Sep 1988).

't Hooft proposed a model where quarks are confined by a chromomagnetic Meissner effect along the N-1 U(1) directions of the maximal Abelian subgroup of SU(N). This is the Abelian projection. I show that this model successfully interpolates from low N, where quarks are confined in a baglike region of perturbative vacuum embedded in the true nonperturbative vacuum, to the large-N limit. At large N quarks are confined in a "shallow" nonperturbative medium and the string tension is an N-independent constant. Confinement of adjoint quarks also properly evolves from screening at small N to confinement at infinite N with a string tension twice as large as for quarks in the fundamental representation.

52607 **Methods of extrapolating the t-expansion series.** Stubbins, C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309). *Physical Review [Section] D: Particles and Fields;* **38**: No. 6, 1942-1949(15 Sep 1988).

We present four new methods in addition to the standard methods of extrapolating the t-expansion series and make a comprehensive comparison of these procedures by applying them to the t series for three quantum systems. We have found that by writing the series as a ratio of decreasing exponentials it is possible to devise methods that are significantly more accurate than the standard methods for low-order series. By studying the function t(E) we have found a procedure that is more accurate than the standard methods for all t-series orders in two cf the test systems.

52608 **Implementation of stratified sampling for Monte Carlo applications.** Brown, R.S. Jr.; Hendricks, J.S. (Univ. of Arizona, Dept. of Nuclear Engineering, Tucson, AZ (US)). *Nuclear Science and Engineering;* **97**: No. 3, 245-248(Nov 1987).

Stratified sampling is a method used in Monte Carlo calculations to take advantage of certain known aspects of probability distributions. The sampling region is subdivided into discrete subregions, and each of these is sampled a preassigned number of times. A form of stratified sampling has been implemented into a major Monte Carlo particle transport computer code with very encouraging results.

65 PHYSICS II

REFER ALSO TO CITATION(S) 51380

52609 **(INIS-SU—9/A) Proceedings of seminar, devoted to the 75-th anniversary of D.I. Blokhintsev.** (Joint Inst. for Nuclear Research, Dubna (USSR)). 1986. 214p. (In Russian). (CONF-8301122—). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW.

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

The individual papers in these proceedings were abstracted and indexed separately.

52610 **(INIS-SU—46) Experimental and theoretical physics. Collection.** (AN SSSR, Moscow. Fizicheskij Inst.). 1987. 54p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780179/JAW.

The papers in this collection have been abstracted and indexed separately.

52611 **(OUP—88-08) List of publications 1987.** (Oslo Univ. (Norway). Fysisk Inst.). May 1988. 41p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754751/JAW.

This annual bibliography of publications from University of Oslo, Department of physics refers to research reports, contribution to newspapers and scientific journals, guest lectures, and popular science lectures.

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 51103, 52467, 52483, 52544, 52683, 52684, 52685, 52787, 52873, 52942

52612 **(BONN-IR—88-05) Photonuclear reactions in the Δ-resonance region.** Arends, J. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Feb 1988. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754308/JAW.

The following review is intended to give an overview of the experimental information on photon-induced reactions in comparison with theoretical calculations. Most of the experimental data presented here, were measured at the Bonn 500 MeV synchrotron. In section II the experimental techniques used for the measurements are briefly described. Section III deals with the most inclusive information, the total hadronic photoabsorption cross section. In sections IV and V, pion production and proton emission channels are discussed. A brief outlook to prospects for future photonuclear experiments at the new electron stretcher ELSA is given in section VI. (orig./HSI).

52613 **(CNIC—00073) Charged particle induced prompt nuclear reaction and its applications.** Zhao Yuhua. (Academia Sinica, Beijing (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Sep 1987. 18p. (In Chinese). (IAE—0020). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704092/JAW.

Charged particle induced prompt nuclear reaction analysis (PNR) not only can analyze the content and concentration of elements in sample sensitively and accurately, but also can measure the distributions of elements with depth in surface and near surface layer. And the method is very simple, rapid and nondestructive, and has good depth resolution. So the PNR is very widely used in many modern science and technique field such as solid state physics, surface physics, electrochemistry, metallurgy and material science and so on. This paper deals with the principle, method and the features of the nuclear reaction analysis induced by charged particle. Especially, the distribution analysis of impurities in sample with depth and the improvement of the depth resolution are discussed in detail. Some actual examples of its application are given.

52614 **(CNIC—00075) Thickness and uniformity measurements of nuclear targets.** Xu Guoji; Meng Xiangjin; Luo Xinghua; Guan Shouren. (Academia Sinica, Beijing (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). Jun 1987. 9p. (In Chinese). (IAE—0021). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704093/JAW.

This paper introduces the methods of target thickness and uniformity measurements including weighing, α-particle thickness gauge, quartz thickness gauge, optical transmittance and Rutherford backscattering. An α-particle gauging which measures target thicknesses up to several μm is metioned. A fast thickness measurements for C, Au and Cu targets by spectrophotometer is given. A high sensitive quartz gauge which can measure minimum deposit of 0.04 μg/cm/sup 2/ is described. Thickness and impurity determinations by RBS with accuracy better than 5% are summarized.

52615 **(DOE/ER/40256—3) Cyclotron based nuclear science: Progress report, April 1, 1987-March 31, 1988.** (Texas A and M Univ., College Station (USA). Cyclotron Inst.). Aug 1988. Contract FG05-86ER40256. 132p. NTIS, PC A07/MF A01. Order Number DE88017093/JAW.

This report discusses experiment run on the K500 cyclotron and 88 in cyclotron at Texas A&M University. The main topics of these experiments are: Heavy ion reactions; Nuclear structure and fundamental interactions; Atomic and material science; Nuclear theory; and Superconducting cyclotron and instrumentation. (LSP)

52616 **(DOE/ER/40269—T1) [Intermediate energy nuclear physics]: Technical progress report.** (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). 15 Aug 1988. Contract FG02-86ER40269. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88016837/JAW.

This report summarizes work carried out between October 1, 1987 and August 1, 1988 at the Nuclear Physics Laboratory of the University of Colorado, Boulder, under Contract DE-FG02-86ER40269 with the United States Department of Energy. The contract supports experimental work in intermediate energy nuclear physics. The experimental program is very broadly based, ranging from pion-nucleon studies at TRIUMF, to inelastic pion scattering and charge exchange reactions at LAMPF, to nucleon charge exchange at LAMPF/WNR and to electron scattering at NIKHEF. In addition, a number of other topics related to accelerator physics are described in this report.

52617 **(DOE/ER/40413—1) Studies of relativistic heavy ion collisions: Annual progress report, July 16, 1987--July 31, 1988.** Madansky, L. (Johns Hopkins Univ., Baltimore, MD (USA)). [1988]. Contract FG02-88ER40413. 215p. NTIS, PC A10/MF A01. Order Number DE88016483/JAW.

The following reports outline the progress of our two-fold program in relativistic heavy ion studies. First of all, a signature for new phenomena in hot, dense nuclear matter may be possible by the observation of lepton pairs in heavy ion collisions. Our experiments have already shown the important sources of lepton pairs from pion annihilation. A second signature of possible new phenomena was a study of lambda polarization in heavy ion collisions. Our group was part of a collaborative effort in the study using polarized beams and the results to date are presented here. In this connection, our group undertook to study in a preliminary way the production of the lambda hyperon in silicon-aluminum collisions at the AGS. Future experiments on hyperon studies in general will be done in collaboration with the BNL 810 collaboration. The Hopkins group has also participated in experiments on subthreshold production of K-mesons and antiprotons at the Bevalac. Finally, an effort to employ Cerenkov ring-imaging techniques to identify lepton pairs within the high flux of protons and mesons from the heavy ion collisions has been initiated at LBL.

52618 (INDC(NDS)—192/L, pp 72-74) **Covariances of evaluated nuclear data based upon uncertainty information of experimental data and nuclear models.** Poenitz, W.P.; Peelle, R.W. (Argonne National Lab., Idaho Falls, ID (USA); Oak Ridge National Lab., TN (USA)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

A straightforward derivation is presented for the covariance matrix of evaluated cross sections based on the covariance matrix of the experimental data and propagation through nuclear model parameters. (author). 9 refs.

52619 (INDC(NDS)—192/L, pp 74-81) **Covariances for measured activation and fission ratios data.** Smith, D.L.; Meadows, J.W.; Watanabe, Y. (Argonne National Lab., IL (USA). Applied Physics Div.). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

Methods which are routinely used in the determination of covariance matrices for both integral and differential activation and fission-ratios data acquired at the Argonne National Laboratory Fast-Neutron Generator Facility (FNG) are discussed. Special consideration is given to problems associated with the estimation of correlations between various identified sources of experimental error. Approximation methods which are commonly used to reduce the labor involved in this analysis to manageable levels are described. Results from some experiments which have been recently carried out in this laboratory are presented to illustrate these procedures. (author). 13 refs, 1 fig., 5 tabs.

52620 (INDC(NDS)—192/L, pp 81-84) **Method to evaluate covariances for correlated nuclear data.** Kanda, Y.; Uenohara, Y. (Kyushu Univ., Fukuoka (Japan). Dept. of Energy Conversion Engineering). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

A method to evaluate covariances for nuclear data has been developed by applying Bayesian method with B-spline functions and logarithms of experimental data. A point of the method is adoption of the B-spline function. Applicability of the method to nuclear data evaluation is presented with a few simple examples. (author). 7 refs, 2 figs.

52621 (INDC(NDS)—192/L, pp 85-89) **Covariances obtained in simultaneous evaluation of fission and capture cross sections for heavy nuclides.** Kanda, Y.; Uenohara, Y. (Kyushu Univ., Fukuoka (Japan). Dept. of Energy Conversion Engineering). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

Simultaneous evaluation of the fission cross sections for five nuclides and capture cross sections for two nuclides have been performed by using fourteen experiments including absolute and ratio measurements. A generalized least squares method is applied with

the B-spline functions and logarithms of the data. The obtained covariances are presented and discussed. (author). 4 refs, 4 figs.

52622 (INDC(NDS)—192/L, pp 89-97) **EVAL: An interactive facility for multiparametric covariant evaluation.** Bastian, C. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

EVAL is designed for the evaluation of a set of nuclear parameters out of an overdetermined set of measurements of their combinations. Written in the interpreted language APL, it allows the full-screen interactive input and edition of the evaluation data base. Sorting of the measurements in independent groups, least-squares fitting and display of the fitted parameter values are performed by further interactive commands. As a cross-check, an inference procedure may situate the measured data with respect to the evaluated parameters on common diagrams. (author). 2 refs, 8 figs.

52623 (INDC(NDS)—192/L, pp 102-110) **Use of covariance informations for integral experiment planning.** Palmiotti, G.; Salvatores, M. (Compagnie Internationale de Services en Informatique (CISI). Agence de Cadarache, 13-Saint-Paul-lez-Durance (France); CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

The present note describes briefly the application of basic data covariance matrix informations to the optimization of integral experiments, in order to reduce design parameter uncertainties. In conclusion it can be said that the impact of the introduction of the correlations is not negligible, even if we have considered only a limited number of them. It is then evident that appropriate estimates of the dispersion matrices should be used to properly assess the interest of a specific series of experiments. A substantial reduction of uncertainty can justify an experiment, only if reliable uncertainty data are used. It is also evident that for this type of study, only simple, broad group averaged data, easy to handle, are useful. 3 refs, 7 tabs.

52624 (INDC(NDS)—192/L, pp 111-113) **Covariances for adjusted derived quantities.** Poenitz, W.P. (Argonne National Lab., Idaho Falls, ID (USA)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

A procedure is reviewed for the adjustment of derived quantities and the derivation of their covariance based upon a set of parameters and additional data with their covariances. (author). 13 refs.

52625 (INDC(NDS)—192/L, pp 113-118) **Evaluation and application of redundant-cross-section covariances.** Muir, D.W. (Los Alamos National Lab., NM (USA)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

Certain multigroup covariance libraries, notably COVFILS-2, omit all redundant (or summed) reactions on the grounds that the information content of a well-measured total cross section, for example, is implicitly contained in the covariances of the component, or partial, reactions that add up to the total. We analyze this strategy and show that, while redundant reactions can play an important role in cross-section and covariance evaluation, their omission from libraries intended for applications is justifiable. (author). 3 refs.

52626 (INS-T—478) **Preprint data base system at INS: INSPREP system.** Shinohara, M.; Ukai, K.; Fujiyoshi, N. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1988. 23p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754553/JAW.

The library at the INS (Institute for Nuclear Study) receives several tens of preprints a week from foreign and domestic laboratories and universities. These preprints are pigeonholed by making a catalog card index carried a title, authors, an accession number, classification of fields, etc. A newly arrived preprint lists is also served every week. The cataloging and weekly lists publishing works were handled with a typewriter. And then, it was very difficult and tedious to correct/check/file the index cards and to correct/check the weekly preprint lists. To make a preprint data efficiently by a computer and to refer this data base by on-line without using a index card, the INSPREP system is constructed. The INSPREP system consists of two parts. One is named a PREPINS, and is used to make a preprint data, builds a preprint data base, and publishes a weekly preprint lists. The other, called a PREP, performs an on-line retrieval for this data base. The preprint data base consists of following items such as an author, a title, an accession number, a report number, a classification field, etc. The PREPINS can be used by limited persons for security. User can search a preprint by inputting above mentioned items. The PREP adopts a menu method. Then, user can perform an on-line retrieval very easily.

52627 (JAERI-M—88-065, pp 4-9) **Outline of JENDL-3T.** Asami, Tetsuo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The compilation of the Japanese Evaluated Nuclear Data Library, Version 3 (JENDL-3) is now in progress aiming at the completion in 1988. The data evaluation has been almost finished, and the data assembling, the error checks, the consistency checks and so on have been continued. On the other hand, various benchmark tests started at the beginning of 1987 for these data of some important nuclides. JENDL-3T is a temporary file which was particularly prepared for these benchmark tests. The data in JENDL-3T could be revised partly in the basis of the results of the benchmarks. An outline of JENDL-3T is given together with various problems encountered in the compilation work for JENDL-3.

52628 (JAERI-M—88-065, pp 29-56) **Nuclear data evaluation for medium and heavy nuclei.** Mizumoto, Motoharu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Present status of nuclear data evaluation works for medium and heavy nuclei is described in this paper. These data are being prepared for JENDL-3 (Japanese Evaluated Nuclear Data Library-Version 3). At present, about a half of the data files, which are expected to be stored in the final library, has been brought into a temporary library called JENDL-3T. The remaining works and additional revisions are still needed to be made in order to finalize the data library as JENDL-3. Special emphases have been put on the high energy neutron data for which the previous JENDL-2 had some inadequacies, and gamma-ray production cross sections have been newly evaluated. Systematic and consistent evaluations have been intended for the new evaluations.

52629 (JAERI-M—88-065, pp 191-197) **Dosimetry benchmark test of JENDL-3T.** Nakazawa, M. (Tokyo Univ. (Japan)). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

As a part of "Integral-Test Program of JENDL-3T", dosimetry benchmark test has been started in the dosimetry sub-working group, through which it is planed to produce the special purpose

file for dosimetry from the JENDL-3. Presently, the 35 dosimetry reactions have been tested in the benchmark fields of Cf-252/U-235 fission spectra, CFRMF, YAYOI and JAERI-FNS 14 MeV neutron. Several systematic discrepancies have been found in the following reactions of Al-27(n,α), S-32(n,p), Fe-54(n,p), Fe-58(n,γ), Ni-58(n,p), Ni-60(n,p), U-235(n,f) and U-238(n,γ).

52630 (JINR—D-1,2-86-668, pp 251-260) **Composite particles and entropy production in relativistic nuclear collisions.** Gustafsson, H.A.; Doss, K.G.; Gutbrod, H.H. and others. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The data on composite particle (d, t, /sup 3/He, /sup 4/He) production as a function of multiplicity for different colliding systems (Ca+Ca, Nb+Nb, Au+Au) and energies have been presented. These data can be understood by the improved coalescence model. The obtained radii for the interacting volume give chemical freezout densities close to normal nuclear density. The results on entropy production in the systems studied by considering two different models for the determination of the entropy have been also presented. The results show large differences showing that the determination of entropy in nuclear collisions is strongly model dependent. Favouring the model by Stocke has concluded that compression is achieved in the collision and that the no-compression fireball model produces too much entropy. A further distinction between compressional potential- and compressional kinetic energy is not possible since these two quantities are not independent of each other. A determination of the proper equation of state from data would be improved by a model which does not need to extrapolate from the finite size volumes in nuclear collisions to that of infinite matter, but rather uses the higher accuracy of the experimental data themselves. 19 refs.; 8 figs.; 2 tabs.

52631 (JINR—D-1,2-86-668, pp 298-307) **Charge-exchange reactions with relativistic complex nuclei at Saturne.** Radvanyi, P.; Tinsley, J.; Bachelier, D. and others. (9100652FR; Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Charge-exchange reactions above about 100 MeV per nucleon are a very effective and selective way of producing collective spin excitations in nuclei. These excitations are particularly strong at 0 deg and small angles. The aiming to study a possibility, at the beginning of 1982, an extensive experimental programme on charge-exchange reactions, are stated at Laboratory National Saturne. The first experiment showed indeed a strong excitation of the Δ resonance in the (/sup 3/He, t) reaction at 2 GeV and 0 deg. In order to investigate of the inverse (n, p) type charge-exchange reaction, the (d, /sup 2/He) reaction is observed at Saturne. Using the relativistic /sup 12/C, /sup 14/N, /sup 16/O and /sup 20/Ne beams available at Saturne, are initiated a charge-exchange heavy-ion programme. It is possible with the same ion, e.g. /sup 12/C or /sup 20/Ne, to study and compare (p, n) and (n, p)-tupe reactions. measurements have been performed between 0.32 and 1.1 GeV per nucleon. It is concluded that, the Δ resonance is observed in /sup 12/C8/sup 12/C, /sup 12/B) is weaker than in /sup 12/C(/sup 20/Ne, /sup 20/F), it is still weaker than in the /sup 12/C(/sup 12/C, /sup 12/N) reaction. 15 refs.; 12 figs.

52632 (JINR—D-1,2-86-668, pp 236-242) **Alpha-particle interactions with nuclei at 12A GeV/c.** Otterlund, I. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Collision processes of α particles with the energy of 12 A GeV/s with emulsion G5 nuclei are studied at CERN accelerator. The experimental data are given: pseudorapidity distributions of shower particles in α-Em reactions at 12 A GeV in the region of central and peripheral collision, distributions of longitudinal momenta of protons and deuterons in αα-collisions for two intervals of transverse momenta. Reactions of quasi-elastic proton scattering and spectator-fragment production are considered. Distributions in pseudorapidity for spectators and quasi-elastic scattered protons as well as distribution of the number of nucleons participations from target nucleus given for all the values of impact parameter and spectator-forbidden events are given. The results of /sup 4/He+/sup 108/Ag reaction simulation by the Monte-Carlo method with a phenomenological nucleon model are compared. 8 refs.; 5 figs.

52633 (JINR—D-1,2-86-668, pp 290-297) **Inclusive spectra of light products of relativistic nuclei interactions in kinematical region of target-nucleus fragmentation.** Man'ko, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Inclusive spectra of protons emitted in interactions of 3.6 GeV/nucleon ions /sup 12/C and 4.9 GeV/nucleon ions /sup 3/He with C, Cu, Sn, Pb nuclei are measured. Analysis of these data in the framework of a nuclear fireball model as well as data presenting nucleus-nuclear interactions with another energies (0.8 and 2.1 GeV/nucleon) and for another combination of colliding nuclei (from /sup 3/He+C to Ar+Pb) has shown that the invariant cross section in the region of nucleus-target fragmentation is described by a certain universal function, if one goes into a suitable moving coordinate system. 10 refs.; 10 figs.; 1 tab.

52634 **(KFK—4052) KfK, Institute for Nuclear Physics. Report of results on research and development work 1985.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Feb 1986. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754668/JAW.

The Institute for Nuclear Physics consists of three partial institutes. The partial institutes IK I and IK II and the Institute for Technical Physics (ITP) were jointly operated with the Institute for Experimental Nuclear Physics of the Karlsruhe University. The Institute for Nuclear Physics comprehends following directions of work: nuclear and elementary-particle physics in the range of low, intermediate, and high energies; contributions to the heating techniques of fusion plasmas and to the production of high energy densities. (orig./HSI).

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 52668

52635 **Recent References: January through April 1988.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973). *Nuclear Data Sheets;* **54**: No. 3, 413-521(Jul 1988).

This July 1988 issue of Nuclear Data Sheets is the four-month index to recent references to experimental nuclear structure data. (The National Nuclear Data Center maintains a complete computer file of references to the nuclear physics literature. A complete master file of Nuclear Structure References (NSR) is maintained by the National Nuclear Data Center.) (AIP)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

52636 (JINR—D-1,2-86-668, pp 308-318) **Manifestation in (/sup 3/He,t) exchange processes at high-energy dominant Δ-isobar excitations of target nucleus and their collective character.** Eliseev, S.M.; Zaporozhets, S.A.; Inozemtsev, V.I. and others. 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Experimental study of spin-isospin excitations of nuclear matter with {similar←to} 300 MeV energy transfer has been actively carried out lately including (/sup 3/He,t)-charge-exchange reactions. The experimentation permitted to detect for the first time the fact that at high energies charge-exchange cross section on a nucleus was mainly determined by the contribution of high ({similar←to} 300 MeV) spin-isospin excitations of nuclear matter and that the behaviour of /sup 12/C(/sup 3/He,t)- and p(/sup 3/He,t)-reaction cross sections differed qualitatively. On the basis of the results of (/sup 3/He,t) and (p,n) charge-exchange data analysis carried out, the authors suppose that the reasons leading to collective phenomena at Δ-isobar nucleus excitation in these reactions and in PIA-interactions in the resonance region of pion energies have something common for these processes charecter. 19 refs.; 6 figs.

52637 **Transverse energy production and the equation of state of nuclear matter.** Doss, K.G.R.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.W.; Lohner, H.; Ludewigt, B.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R. (Accelerator Lab. of Saskatchewan (CA)). *Modern Physics Letters B;* 3: No. 9, 849-858(Aug 1988).

In nuclear collisions of Au + Au, Nb + Nb and Ca + Ca bombarding energies between 150 and 800 MeV per nucleon, transverse energy and transverse momenta of light particles are studied event by event at $\theta = 90°$ in the center of mass system. At all energies, a rise of the mean transverse energy per nucleon is observed with increasing charged particle multiplicity. Particularly large values of E/sub perpendicular/ have been found for /sup 3/He-fragments. The hydrodynamical picture is discussed for a possible separation of the collective flow and the thermal parts of the E/sub perpendicular/-spectrum. From this evidence for a rather stiff equation of state is found.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

52638 **(BNL—41522) A search for bound states of the {eta}-meson in light nuclei.** Pile, P.H. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 6p. (CONF-8805142—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015855/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

This paper describes an experiment designed to search for a new form of nuclear matter--a bound {eta}-nucleus system. The (π^+,p) reaction was used to study the possible formation of an {eta}-mesic nucleus. No narrow {eta}-nuclear bound states were observed using ^{7}Li, ^{12}C, ^{16}O and ^{27}Al targets. 7 refs., 4 figs., 1 tab.

52639 (INIS-SU—40/A, pp 5-21) **Universality of four-dimensional baryonic cluster properties in hadron-nuclear and nucleus-nuclear interactions within the 4-40 GeV energy range.** Armutlijski, D.; Baldin, A.M.; Grishin, V.G.; Didenko, L.A.; Kuznetsov, A.A.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Tbilisskij Gosudarstvennyj Univ. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780099/JAW. (N—4(24)-87).

In JINR rapid communications. Collection.

The properties of baryonic clusters in various hadron-nuclear and nucleus-nuclear interactions: pC, dC, CC, pTa, dTa, π/sup -/C, in a wide energy range are studied in a new relativistically-invariant approach. Distributions of clusters and individual protons in clusters are analysed over relative 4-velocities squared b/sub ik/. It is shown that in relativistic nuclear interactions two characteristic region exist: one of them corresponds to the case of classical nuclear physics b/sub ik/ {similar←to} 10/sup -2/, the second is intermediate where quark-gluon degrees of freedom begin to play an essential role b/sub ik/ {similar←to} 10/sup -1/. It is also shown that the properties of 4-dimensional baryonic clusters in both regions do not depend neither on a type of a projectile nor its energy. 21 refs.; 11 figs.; 5 tabs.

52640 (JAERI-M—88-065, pp 365-373) **Measurements of double-differential neutron emission cross sections.** Baba, M.; Ishikawa, M.; Kikuchi, T.; Wakabayashi, H.; Hirakawa, N. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

A brief description is presented on recent works of double-differential neutron emission cross sections measurements at Tohoku university Dynamitron accelerator facility. Typical results of measurements and analyses are shown as well as the method of experiment and data analyses.

52641 (JAERI-M—88-065, pp 374-387) **Differential cross sections for gamma-ray production by 14 MeV neutrons.** Yamamoto, Junji; Murata, Isao; Takahashi, Akito; Sumita, Kenji. (Osaka Univ., Suita (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Gamma-ray production cross sections were measured for (n,xγ) reactions by 14 MeV neutrons using the D-T neutron source OKTAVIAN of Osaka University. Energy differential cross sections are given for five samples of aluminum, silicon, chromium, iron and nickel over the energy region from 0.5 to 10 MeV. Angular distribution of discrete gamma-rays is also presented for 4.44 MeV gamma-rays from (n,n') reaction in /sup 12/C. Measured cross sections were compared with the differential data evaluated in currently used nuclear data files of JENDL-3T and ENDF/B-IV.

52642 (JAERI-M—88-065, pp 433-444) **/sup 7/Li + P vector reactions at 12, 14 and 16 MeV.** Koori, N.; Kumabe, I.; Hyakutake, M. and others. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Double differential cross sections and analyzing powers for / sup 7/Li(p,p'), (p,d) and (p,t) reactions have been measured at incident energies of 12, 14 and 16 MeV. Experimental results are briefly summarized. Theoretical analyses are also given; two sets of the optical potential parameters were obtained from calculations based on the spherical optical model and based on the coupled channel method. Furthermore, adoptability of the coupled discretized-continuum channel method and final state interaction theory are discussed for continuum regions of proton and triton energy spectra, respectively.

52643 **(JAERI-M—88-164) Revision and status of the neutron nuclear data of ^{6}Li and ^{7}Li.** Chiba, Satoshi; Shibata, Keiichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Physics Div.). Aug 1988. 63p. (NEANDC(J)—131/U; INDC(JPN)—117/L). U.S. Sales only; domestic audience. Japan Atomic Energy Research Institute, Information Division, Department of Technical Information, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan. Order Number TI88016511/JAW.

The neutron nuclear data of ^{6}Li and ^{7}Li stored in JENDL-3PR1 have been partly revised for JENDL-3 by taking account of the experimental data measured after their evaluations. The revision was mainly based on the double-differential neutron emission cross section data measured in Japan. The ^{7}Li(n,n't)α reaction cross section was slightly enhanced around 14 MeV on the basis of recently measured data using the tritium counting method. The spectra of the continuum secondary neutrons produced by the ^{6}Li(n,n'd)α and ^{7}Li(n,n't)α reactions were calculated by the three-body phase-space model with the Coulomb interaction between the two charged particles in the final states. In the evaluate files, they were described by about 30 pseudo levels with a 0.5 MeV internal. The secondary neutron spectra from the ^{6}Li(n,2n) and ^{7}Li(n,2n) reactions were given by the conventional evaporation mode. Two higher resonant states, which had not been contained in the JENDL-3PR1 evaluation, were included in the present evaluation for each nuclide. A

coupled-channel calculation was performed to interpolate and extrapolate the elastic and some inelastic scattering cross sections. The present revision was restricted to the neutron emitting reactions. In this report, method of the revision and status of the produced data files are described. 96 refs., 38 figs., 2 tabs.

52644 (JINR—D-1,2-86-668, pp 119-122) **Search for exotic baryon systems in the breakup reactions of relativistic nuclei.** Andreeva, N.P.; Anzon, Eh.V.; Bubnov, V.I.; Gajtinov, A.Sh.; Kanygina, Eh.K.; Chasnikov, I.Ya.; Shakhova, Ts.I. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The results of search for hypernuclei among single-charged fragments in interactions of carbon and neon relativistic nuclei in nuclear ptotoemulsions are presented in this paper. BR-2 photoemulsions irradiated by /sup 12/C and /sup 22/Ne nuclei at P/sub 0/=4.1 GeV/c per a nucleon at the JINR accelerator are used. The value of λ free path is turned out to be approximately 2 times less than the λ value for α particles in case of identified /sub λ// sup 4/H hupernuclei with mass and energy similar to α particle mass and energy. It is noticed that there are 4 candidates for /sub λ//sup 4/H from 6 fragments. So, these four nuclei and one /sub λ//sup 3/H nucleus are detected in total breakup reactions of a nucleus-projectile. 7 refs.; 3 figs.

52645 (JINR—R-1-87-374) **Charge-exchange of relativistic helium-3 nuclei to tritons on carbon with excitation of Δ-isobars in target-nucleus.** Ableev, V.G.; Eliseev, S.M.; Zaporozhets, S.A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703375/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The invariant differential cross sections of a helium-3 to triton charge-exchange reaction on carbon nuclei measured at small (Θ <or approx. 0.4 deg) angles with an absolute normalization uncertainty of about 10% at momenta from 4.4 GeV/c up to 10.8 GeV/c and no more than 20% at 18.3 GeV/c are presented. The cross sections are corrected for the spectrometer momentum resolution effects. It is found that a main contribution to the reaction cross section is made by the process of Δ-isobar excitation of the target-nucleus which has signs of collectivity. This conclusion is based (i) on the results of comparison of these data with those on a p(/sup 3/He,t)Δ/sup ++/ reaction, (ii) on the analysis of the Fermi-motion effects and (iii) on the calculations of Δ-isobar production cross sections dσ/dΔ(0 deg) for charge-exchange reactions on the nucleus and a free proton. 21 refs.; 5 figs.; 2 tabs.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

52646 (BNL—41608) **Collisions at 14.5 GeV per nucleon: The study of baryon-rich matter at high energy.** Tannenbaum, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 29p. (CONF-8806117—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015815/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

The AGS-Tandem accelerator complex at Brookhaven National Laboratory is briefly described. Experiments have been performed with a 160 beam of total energy 232 GeV and a 28Si beam of total energy 406 GeV. A summary of the experimental results is presented. It is shown that 160 and 28Si nuclei at the incident momentum of 14.5 GeV/c per nucleon can be substantially stopped by nuclei the size of Cu. Preliminary results on inclusive production of identified pions, kaons, protons and lambda particles are also discussed. 29 refs., 32 figs.

52647 (INIS-mf—11764) **Angular correlation experiments for the study of giant multipole resonances and currents of the second kind in atomic nuclei. Scientific report.** (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Physikalisches Inst.). Mar 1986. 14p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754327/JAW.

The project dealt with angular correlation experiments for the study of giant multipole resonances and currents of the second kind in atomic nuclei. Both partial projects were worked in the period of the report.

52648 (JAERI-M—88-065, pp 344-356) **Cross section measurement and integral test for several activation reactions using T + d and thick-Li + d sources.** Dumais, J.R.; Tanaka, S.; Odano, N.; Iwasaki, S.; Sugiyama, K. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Recent activities on the area of the cross section measurement for several activation reactions at Department of Nucl. Eng., Tohoku Univ. are described. The first subject is the cross section measurement for (n,2n) reaction on aluminum using the RTNS-II neutron source. Cross sections with rather small error band were obtained for the incident neutron energies from 14 to 14.7 MeV. The second one is the status of the program for the integral experiments on several reactions using the thick Li + d source at Tohoku Fast Neutron Lab. The experimental results showed the usefullness of the source as a tool for the cross section assessment.

52649 (JINR—R-1-87-239) **Correlations in fragmentation of the neon-22 relativistic nucleus with momentum P/sub 0/=90 GeV/c and dynamics of this process.** Krasnov, S.A.; Tolstov, K.D.; Shabratova, G.S. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703373/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The correlation between the fragmentation products of relativistic residual neon-22 nucleus have been investigated. The value of the fragmenting nucleus transverse momentum was estimated. It is shown that in this case the transverse motion of nucleus distorts strongly the veritable momentum charateristics of fragments and values, characterized the fragmentation process. The quantitative comparison of the data with the calculation by the fast fragmentation statistical theory has been done. The dependences of the main characteristics of fragmentation process on the fragmenting nucleus mass, degree of its disintegration and target nucleus mass were investigated. 13 refs.; 6 figs.; 4 tabs.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

52650 (JAERI-M—88-065, pp 212-235) **Energy spectra of particles emitted from (p,n), (n,p), (p,α), (n,α), (p,p'), (n,n') and (p,d) reactions on nuclei around magic number.** Kumabe, I.; Watanabe, Y.; Koori, N. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The energy spectra of particles emitted from (p,α) and (p,p') reactions on nuclei around magic number with 18 MeV protons were measured in order to clarify the shell and odd-even effects in the preequilibrium processes. From the experimental results, it was found that there exist no appreciable shell and odd-even effects in energy spectra for the preequilibrium (p,α) and (p,p') reactions. The energy spectra for (p,n), (n,p), (p,α), (n,α), (p,p') and (n,n') reactions were analyzed in terms of the preequilibrium exciton model introducing effective Q-values, the pairing correlation, and the modified uniform spacing model in which the uniform spacing model is modified so as to have a wide spacing at the magic

number. The calculated spectra using the above model show good agreement with the experimental ones. The fine structures of the energy spectra for the (p,α) reactions on nuclei around atomic number 50 can be qualitatively explained using the three-nucleon pickup model under the assumption that the states excited in the (p,α) reaction are formed by the coupling of two-neutron hole states excited in the (p,t) reaction and one-proton hole states excited in the (d,/sup 3/He) reaction. The similar three-nucleon pickup model can explain qualitatively the fine structures of the energy spectra for the (n,α) reactions on nuclei around neutron numbers 50 and 82. The energy spectra for the (p,d) reaction on Mo isotopes were also measured and analyzed.

52651 (JAERI-M—88-065, pp 407-414) **Measurement of formation cross-sections of short-lived nuclei produced by 14 MeV neutron.** Katoh, Toshio; Yoshida, Hiroyuki; Osa, Akihiko and others. (Nagoya Univ. (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Measurements of formation cross-sections of short-lived nuclei produced by 14 MeV neutron were made by using the Intense Neutron Source(OKTAVIAN) for the energy range of 13.40 MeV and 14.87 MeV. Measured reactions were /sup 92/Mo(n,2n), /sup 92/Mo(n,α), /sup 63/Cu(n,2n), /sup 65/Cu(n,α), /sup 90/Zr(n,2n), /sup 55/Mn(n,α) reactions.

52652 (JAERI-M—88-065, pp 486-501) **Calculation of double differential cross sections for structural materials by PEGASUS code.** Sugi, Teruo; Nakagawa, T.; Nishigori, T.; Iijima, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The neutron induced neutron and proton emission double differential cross sections were calculated with PEGASUS code for Cr, Fe and Ni and their isotopes. Results are in fair agreement with experimental data for neutron energy near 14 MeV, confirming that PEGASUS may be applied successfully to produce the double differential cross section data for JENDL.

52653 **Measurement of the 1f/sub 7/2/-neutron-orbit radius in /sup 41/Ca.** Platchkov, S.; Amroun, A.; Bricault, P.; Cavedon, J.M.; de Witt Huberts, P.K.A.; Dreux, P.; Frois, B.; Goodman, C.D.; Goutte, D.; Martino, J.; and others. (Departement de Physique Nucleaire/HE, Centre d'Etudes Nucleaires de Saclay, F-91191 Gif-sur-Yvette, France). *Physical Review Letters;* **61**: No. 13, 1465-1468(26 Sep 1988).

The magnetic form factor of /sup 41/Ca has been measured by elastic electron scattering in the momentum-transfer range between 1.8 and 3.3 fm/sup -1/. The 1f/sub 7/2/-neutron-orbit radius inferred from this data definitively demonstrates that the explanation of the Coulomb-energy anomaly cannot be found in a reduction of the valence-orbit radius.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

52654 (INIS-mf—11762) **Excitation of giant resonances in /sup 64/Zn by electron scattering and their decay properties.** Khan, S. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1987. 82p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754325/JAW.

The reaction /sup 64/Zn(e,e'c) was measured at the Mainz microtron MAMI A at an incident energy of 183.4 MeV under the momentum transfers q = 0.36, 0.47, and 0.62 fm/sup -1/. A model-independent multipole decomposition of the /sup 64/Zn(e,e'p) and /sup 64/Zn(e,e'α) spectra makes both E1 respectively E2 (E0) form factors and the spectral density of the corresponding strengths accessible. The difference of radiation-tail corrected /sup 64/Zn(e,e') spectra and coincident (e,e'c) cross section yields /sup 64/Zn(e,e'''n'') spectra as estimation of the decay contribution of the neutrons. These are also accessible to multipole decomposition with the determined form factors. The E1-strength distributions of all charged decay channels exhaust in the measured excitation range the energy-weighted sum rule (EWSR) to 54%. The exhaustion of the isoscalar EWSR by the extracted E2 (E0) strength extends in the charged channels to 67% and by inclusion of the neutron channel to 127%. The analysis of the angular correlation of the α/sub 0/ channel yields a farly on ω independent relative phase of the E1 and E2 decay amplitudes of ≅ 90/sup 0/. (orig./HSI).

52655 (JAERI-M—88-065, pp 57-74) **Evaluation of FP cross sections for JENDL-3.** Kawai, Masayoshi. (Japanese Nuclear Data Committee, Tokai, Ibaraki (Japan)). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Evaluation work of cross sections of fission product nuclides for JENDL-3 is in progress as an activity in JNDC FPND subworking group. Compared to JENDL-2, the number of FP nuclides is extended to 172 by adding As, Se, Br, Sn and Te isotopes and short lived nuclides. Threshold reaction cross sections are also newly contained in the scope of genearal applications. Resonance parameters are evaluated by taking account of recent experimental data up to 1987. The nuclear model parameters are determined for calculating neutron cross sections with the spherical optical model and the statistical theory. The (n,2n), (n,p), (n,α), (n,np) and (n,nα) cross sections are evaluated for all FP nuclides by using the simple evaporation and preequilibrium model. In this paper, evaluation scope and its present status are described.

52656 (JINR—D-1,2-86-668, pp 283-289) **Inelastic collisions of neon 22 nuclei with photoemulsion at 4.1 A GeV/c.** Tolstov, K.D. 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Inelastic collisions of neon-22 nuclei accelerated at the JINR synchrophasotron with BR-2 photoemulsion nuclei are investigated. Colliding nuclei fragmentation including their total disintegration, pion production, correlation ratios are studied. There are particular cases of /sup 22/Ne-emulsion collisions, i.e. manifestation of collective effects in inelastic collisions of relativistic nuclei. 8 refs.; 8 figs.; 2 tabs.

52657 (KURRI-TR—291, pp 20-22) **Half-life measurements of gamma-rays in light fission products using JOSEF.** Kawade, Kiyoshi; Sistemich, K.; Lhersonneau, G.; Ohm, H. (Nagoya Univ. (Japan). Faculty of Engineering). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

A study is made at Joulich Institute to determine the half life of low-energy gamma rays released from light fission products (mass number: 85-110) resulting from irradiation of /sup 235/U and /sup 239/Pu with thermal neutrons. The β-γ delayed coincidence counting method is employed. The mass resolution and separation time of JOSEF (Joulich on-line separator for fission products) is about 40 - 80 and {similar←to}μs, respectively. The use of /sup 239/Pu permits measurement of nuclides that cannot be covered by /sup 235/U. Investigation is made in an effort to cover all nuclides of mass numbers in the range of 85 - 110. In general, a time distribution curve has a linear form when the half-life is longer than 1 3 of the time resolution, while it has the same form as the instantaneous curve with the half-life represented by the shift of the peak centroid when the half-life is shorter then 1 3 of the resolution. Measurements show that the half-life of 53 keV γ-ray in /sup 99/Zr is 8.7 +- 0.5 ns. Observation is also made on the time distribution of 28.5 keV γ-ray in /sup 89/Kr. Its B(M1) is determined from the measured half-life to be {similar←to}10/sup -2/ W.u., indicating that transition is greatly supressed. This demonstrates a similarity between isotons of N = 53(50 + 3) and those of N = 85(82 + 3). (Nogami, K.).

52658 (KURRI-TR—291, pp 56-60) **New neutron deficient isotope /sup 83/Nb.** Kuroyanagi, Tokio; Haruta, Yoshio; Tomura, Hiromi; Min, B.J.; Suematsu, Shigeyuki; Heiguchi, Kazuhiko; Mitarai, Shiro. (Kyushu Univ., Fukuoka (Japan). Faculty of Science). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

The identification of /sup 83/Nb and information on /sup 83/Zr resulting from its beta-decay are important to determine the systematic changes in the properties of nuclei of A = 80 - 90 and to examine the suitability of related nuclear models. Measurements are made of gamma-rays from evaporation residues in the /sup 58/Ni + /sup 28/Si reaction. Since expected gamma-ray peaks are not found in the gamma-ray singles spectrum, the delayed part of the TAC spectrum of the beta-gamma coincidence in the reaction is examined closely. A delayed gamma-ray spectrum is found to contain gamma-ray peaks with the same energy as the gamma-rays that are released from /sup 83/Zr in the first and second excited states. This spectrum contains peaks at 55.6 and 35.5 keV. Strong KX lines is also seen. Analysis of the decay curves of these gamma-rays shows that the half-life of the 24.3 keV and 52.7 keV peaks is 4.3 +- 0.7 and 3.9 +- 0.6 sec, respectively. These gamma-rays are in delayed coincidence with beta-rays and their energies are consistent with those of the gamma-rays from /sup 83m/Zr, indicating that the radiations of 4.1 +- 0.5 sec is ascribed to /sup 83/Nb. Then, a TAC spectrum analysis is made to determine the half-life of gamma-rays from /sup 83m/Zr that is populated by /sup 83/Nb. It is found to be 2.9 +- 0.2 μs. It is suggested that strong KX ray results from internal vonversion due to the gamma-decay of /sup 83m/Zr. From √ N plots of beta-ray spectra in coincidence with gamma-rays and Zr KX ray, the maximum energy of the beta-spectra is estimated at 6.5 +- 0.3 MeV. (Nogami, K.).

52659 (KURRI-TR—291, pp 61-65) **New neutron deficient isotope /sup 85/Nb.** Mitarai, Shiro; Tomura, Hiromi; Haruta, Yoshio; Min, B.J.; Suematsu, Shigeyuki; Heiguchi, Kazuhiko; Kuroyanagi, Tokio; Onizuka, Yoshihiko. (Kyushu Univ., Fukuoka (Japan). Faculty of Science). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

New isotopes /sup 83/Nb and /sup 85/Nb are identified by analyzing the decay process of low-lying levels of /sup 83/Zr and /sup 85/Zr determined from in-beam data. Protons and alpha-particles are mainly released from neutron deficient nuclei away from stable beta-rays. When charged particles are released, it is difficult to identify residues from measurements of gamma-ray sum-energy and multiplicity. A detector to measure the multiplicity of charged particles is constructed and applied to identification of particles. Signals representing the number of particles and alpha-particles are detected together with gamma-ray energy and TAC signals. Spectra gated by one proton and one alpha-particle in the /sup 60/Ni + /sup 28/Si are observed. From these spectra, the number of protons and alpha-particles in each gamma-ray channel can be investigated to determine the z-number of the gamma-ray release nuclides. In addition, neutron-gamma coincidence measurement is made to determine the gamma-rays released by /sup 85/Zr. Isotope decay measurement is compared with calculation of cross sections made according to the statistical theory. As a result, it is concluded that the 50 keV gamma-ray found in this measurement is attributed to the decay of /sup 85/Nb. Positron spectrum is measured in coincidence with 50.1 keV gamma-ray following the decay of /sup 85/Nb and the β/sup +/ end point energy of /sup 85/Nb is determined. It is concluded that the half-life of /sup 85/Nb is 20.9 +- 7 sec. and Q/sub EC/ is 6.3 +- 0.3 MeV. (Nogami, K.).

6517 Nuclear Properties And Reactions, A=90-149, Experimental

52660 (CONF-880896—2) **Angular momentum effects in subbarrier fusion.** Halbert, M.L.; Beene, J.R.; Hensley, D.C.; Honkanen, K.; Semkow, T.M.; Abenante, V.; Sarantites, D.G.; Li, Z. (Oak Ridge National Lab., TN (USA); Washington Univ., St. Louis, MO (USA)). 1988. Contract AC05-84OR21400;AC02-76ER04052. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015286/JAW.

From Symposium on heavy-ion reaction dynamics in tandem energy region; Hitachi, Japan (1 Aug 1988).

Angular-momentum distributions σ/sub L/ for the compound nucleus ^{164}Yb were deduced from measurements of γ-ray multiplicity for all significant evaporation residues from fusion of ^{64}Ni and ^{100}Mo at and below the Coulomb barrier. The excitation functions can be reproduced with coupled-channels calculations only if additional coupling beyond the known inelastic strengths is included. Even with this augmented coupling, however, at the lowest bombarding energies the experimental σ/sub L/ extend to higher L values than the predictions. Single-barrier penetration models for a potential with an energy-dependent depth and shape fitted to the excitation function likewise underestimate the role of high-L partial waves. Somewhat better success is achieved with models in which fission is allowed to occur at distances comparable with or even larger than the Coulomb barrier radius. 24 refs., 3 figs., 2 tabs.

52661 (INIS-mf—11760) **Systematics of the (/sup 18/O,/sup 20/Ne) reaction and its application to the determination of the mass excess of /sup 122/Cd.** Kruechten, B. van. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1987. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754323/JAW.

The aim of the thesis should be the determination of the mass excess of the neutron-deficient nucleus /sup 122/Cd with the (/sup 18/O,/sup 20/Ne) reaction proved for light target nuclei (A < 60) at forward angles. Because the cross section of this reaction at small angles (Θ/sub lab/ ≦ 15/sup 0/) lay below the detection limit of 1 μb/sr it was first necessary to determine optimum kinematical conditions for the study of the reaction /sup 124/Sn(/sup 18/O, /sup 20/Ne). For this purpose systematic studies of the angular distributions of the (/sup 18/O,/sup 20/Ne) reaction on target nuclei with mass numbers between 28 (/sup 28/Si) and 208 (/sup 208/Pb) were performed at beam energies of 82, 102, 141, and 189 MeV. The evaluation of these measurements gave first information on the dependences of the cross sections on energy, Q-value, target mass, and angle. For the /sup 124/Sn(/sup 18/O,/sup 20/Ne)/sup 122/Cd reaction a maximum cross section of about 1 μb/sr at a beam energy 30 MeV above the Coulomb threshold (100 MeV) and a laboratory angle of 40/sup 0/ could be expected. In a new experiment this prediction could be verified. The analysis of the measured spectra yielded a Q-value for the /sup 124/Sn(/sup 18/O,/sup 20/Ne)/sup 122/Cd reaction of 0.1 +- 0.44 MeV. The mass excess of -82.08 +- 0.44 MeV calculated from this for /sup 122/Cd is by 1.5 MeV more positive than the prediction of the Wapstra table. (orig./HSI).

52662 (JAERI-M—88-065, pp 148-161) **Fission-product cross section integral tests and adjustment based on integral data.** Watanabe, T.; Nishigori, T.; Iijima, S.; Kawai, M.; Sasaki, M.; Nakagawa, T.; Matsunobu, H.; Zukeran, A. (awasaki Heavy Industries, Ltd., Tokyo (Japan)). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The integral test of JENDL-2 fission product cross sections was carried out using EBR-II, CFRMF, and STEK data. For strongly absorbing fission-product nuclides, the flux depression corrections were approximately applied, and consistent results were obtained. Using these corrected results, integral test was evaluated on each nuclides again. To see overall consistency, bulk fission-product sample measurements in STEK were also investigated.

Taking into account the moisture correction and standard deviations of experimental data, the C/E deviation from 1 are within 0.1. The adjustment of cross sections based on the above integral test data were also performed using Bayesian least square method. The adjustment are made especially to the nuclides for which only integral data are available (e.g. Xe-132,134 Pm-147, Eu-152,154). Using adjusted cross section, the deviation of C/E from 1 will be within 0.2. Recommendations are given to the evaluation for JENDL-3.

52863 (JAERI-M—88-065, pp 445-459) **Shell and odd-even effects in preequilibrium (p,p') and (n,n') processes.** Watanabe, Y.; Kumabe, I.; Koori, N.; Hyakutake, M.; Takahashi, A. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

We have systematically measured energy spectra of protons emitted from 18 MeV (p,xp) reactions on /sup 90/Zr, /sup 93/Nb, /sup 92,94,96,98,100/Mo, /sup 106/Pd, and Ag, and of neutrons emitted from 14.1 MeV (n,xn) reactions on Ag, Cd, In, Sn, Sb, and Te in order to investigate the shell and odd-even effects in the preequilibrium (p,p') and (n,n') processes. It was found that there are no appreciable shell and odd-even effects in the preequilibrium (p,p') and (n,n') spectra corresponding to excitations above 4 MeV of the residual nuclei. The experimental results were reasonably interpreted using the state densities derived from realistic single particle levels introducing a shell gap. The effect of the direct process in continuum spectrum region was also examined in terms of collective excitations of the low energy octupole resonance(LEOR).

52864 (KURRI-TR—291, pp 42-47) **Decays of /sup 143/La and /sup 145/Ce using KUR-ISOL.** Ukon, Hiroe; Shibata, Michihiro; Kawade, Kiyoshi; Yamamoto, Hiroshi; Katoh, Toshiro; Kawase, Yoichi; Okano, Kotoyuki; Ruan, J.Z. (Nagoya Univ. (Japan). Faculty of Engineering). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

Accurate measurements of beta- and gamma-rays resulting from the decay of /sup 143/La and /sup 145/Ce are made with KUR-ISOL to develop their decay diagram. First, gamma-singles spectrometry is performed to determine the energy and intensity of gamma-rays resulting from the decay of /sup 143/La and /sup 145/Ce. About 30 and 7 peaks are newly identified for /sup 143/La and /sup 145/Ce, respectively, in their gamma-ray spectra. Another gamma-singles spectrometry is carried out using 60 cm/sup 3/Ge(Li) and LEPS detectors to determine 620 keV gamma-ray emission rate in the decay of /sup 143/La. The emission rate is calculated at 4.23 and 4.62 percent from measurements made with Ge(Li) and LEPS, respectively. Gamma-gamma coincidence spectrometry is performed using a 60 cm/sup 3/Ge(Li)-142 cm/sup 3/Ge(Li) or a 60 cm/sup 3/Ge(Li)-LEPS detector. LEPS is then applied to beta-singles spectrometry to determine the maximum energy of the gamma-rays from /sup 143/La and /sup 145/Ce within an error of about 20 keV. The beta-ray end point is determined from the measurements. Decay diagrams of /sup 143/La and /sup 145/Ce are constructed based on these results. The intensity and multipolarity of 18.9, 23.4 and 42.3 keV gamma-rays in the decay of /sup 143/La are determined. Energy and intensity of gamma-rays of 2.8 MeV or above are also determined for /sup 143/La. Three low energy levels of /sup 145/Ce is examined in comparison to the decay diagram of /sup 143/La. /sup 143/Ce is found to have an energy level structure similar to that of other nuclides of N = 85. (Nogami, K.).

52865 (KURRI-TR—291, pp 48-51) **Decay of /sup 93/Rb.** Mitamura, Tohru; Hiromura, Kazuyuki; Aoki, Kazuhiko; Sekioka, Tsuguhisa; Matsui, Hiroshi; Okano, Kotoyuki; Kawase, Yoichi. (Himeji Inst. of Tech., Hyogo (Japan)). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

The isotope mass separator installed at the Research Reactor Institute of Kyoto University (KUR-ISOL) is used to separate /sup 93/Rb (half-life 5.85 sec.) resulting from fission of /sup 235/U and the levels in its daughter nuclide, /sup 93/Sr, resulting from its decay is examined by means of nuclear spectrometric measurements including Eγ, Iγ, γ-γ coincidence and conversion electron observation. Analysis of gamma-ray spectra obtained identifies a total of 241 gamma-ray peaks including those found only in coincidence spectra. The γ-γ measurements are analyzed in relation to 21 gamma-ray gates selected. For each coincident gamma-ray peak in coincidence of the gate gamma-rays, the ratio of its area in the γ-γ coincidence spectrum to that in the singles spectrum is determined. By examining the ratio, it is possible in most cases to determine whether coincident gamma-rays are directly related with those selected as the gates or indirectly related with them. A decay diagram is constructed based on the relations in energy, intensity and coincidence among these gamma-rays. Results obtained demonstrate a high reliability of the method employed in this study. Conversion electron spectrometry is carried out using an Si(Li) and a Ge(Li) detector in combination with a plastic scintillator for beta-ray detection. Analysis of the results has not yet been completed. Some findings are briefly outlined. (Nogami, K.).

52866 (KURRI-TR—291, pp 52-55) **Conversion electron measurements of /sup 147/Ba and /sup 147/La.** Aoki, Kazuhiko; Kawase, Yoichi; Okano, Kotoyuki. (Himeji Inst. of Tech., Hyogo (Japan)). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

Research has been conducted using an on-line isotope separator (KUR-ISOL) for investigation of /sup 147/Ce and /sup 149/Nd resulting from the decay of /sup 147/La and /sup 147/Pr. The report presents some results of a conversion electron spectropic study on the decay of /sup 147/Ba and /sup 147/La. Equipment newly constructed is briefly outlined. It is provided with an Si(Li) detector and plastic scintillator for β-e and β-γ coincidence spectroscopy. Some improvements are made to achieve high efficiency and accuracy. β-γ and β-e coincidence spectra are shown and conversion coefficients determined from the decay of /sup 147/Ba and /sup 147/La are listed. For Ce, conversion coefficients have been determined so far for seven K lines and three L lines. For these three nuclides, new data are obtained concerning the multipolarity of a total of 20 lines. Measurements by γ-γ coincidence spectroscopy are currently under analysis and decay diagrams are not yet available. Some findings obtained so far are briefly discussed in comparison with those previously reported in literature. With the present equipment, β-background is reduced by making measurement in coincidence with β-rays. Tests with /sup 93/Rb and /sup 146/La is made to evaluate the reduction in background. (Nogami, K.).

52867 (UCRL—53839) **The production and use of a ^{148}Gd charged particle target in a spectroscopic study of ^{147}Gd.** Massey, T.N. (Lawrence Livermore National Lab., CA (USA)). 7 Jun 1988. Contract W-7405-ENG-48. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88016186/JAW.

This thesis discusses the nuclear structure of ^{147}Gd elucidated by the neutron pickup reactions (p,d), (d,t) and (^{3}He,α) on the unstable ^{148}Gd target. The neutron pickup reaction on ^{148}Gd probes the two-particle-one-hole states by the pickup of neutrons in the shell model orbitals below the N = 82 gap and one-particle states by pickup of neutrons in shell model orbitals above the N = 82 gap. Our experiments will provide information on the location of neutron single-particle energies which can be used for shell-model calculations in the ^{146}Gd region. The 2-particle-1-hole (2p-1h) states which are probed directly by the neutron transfer reaction in the experiments with the ^{148}Gd target, will bear indirectly on the energies of one-hole states in ^{145}Gd. They will also provide information on the strongest single-particle states in ^{147}Gd because all the single-particle states in the ^{148}Gd target are partially occupied because of the mixing by the pairing interaction. 107 refs., 23 figs., 20 tabs.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

52668 **(BNL—41494) Spectrometer results from BNL E802.** Abbott, T.; Akiba, Y.; Alburger, D.; Beavis, D.; Betts, R.R.; Birstein, L.; Bloomer, M.A.; Bond, P.D.; Chasman, C.; Chu, Y.Y. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-8805142—22). NTIS, PC A02. Order Number TI88015851/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

Measurements of collisions of 14.5 GeV/c per nucleon ^{28}Si ions with nuclear targets using the BNL E802 spectrometer are presented. A description of the experiment and preliminary particle production ratios are discussed. 3 figs., 1 tab.

52669 **(JAERI-M—88-065, pp 246-262) Analysis of transmutation of transuranic wastes by nuclear spallation reactions.** Nishida, Takahiko; Nakahara, Yasuaki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711178—; CONF-8711173—).

From Meeting of the technical committee on safety matters lint to accidents caused by a reactivity transient; Vienna, Austria (17 Nov 1987).

For applying the proton spallation reaction to the transmutation of transuranic products and evaluating its feasibility by a Monte Carlo simulation, preliminary analyses of spallation product yields have been performed by using the NUCEUS code for the proton induced reactions of TRU nuclides. A simulation code NUCLEUS has been developed at JAERI to calculate the nuclear spallation reaction (intranuclear cascade + evaporation and/or fast fission) between a nucleus and a projectile. The results obtained by our code can be compared directly with measured nuclear data obtained by thin foil experiments, in which internuclear multiple collisions have little effects on the data, and will serve to upgrade the calculational methods and the values of nuclear parameters currently used in the calculations. The computational results obtained by using NUCLEUS are reported. Mass and half life distributions of reaction products as well as the number of emitted neutrons have been calculated for the spallation reactions of U, Np and Am with a proton of the energy from 0.5 to 3 GeV. After spallation reactions, a variety of nuclei, especially many neutron-deficient nuclides with nuclear charges not far from that of a target nucleus, are produced as the results of many neutron emissions. From our calculated results that most of them have half lives less than one year, it seems that this transmutation method is promising and has additional merits due to the neutron production also.

52670 **(LBL—25574) Transverse energy and multiplicity distributions in collisions at 60 and 200 GeV per nucleon.** Ritter, H.G. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 13p. (CONF-8806117—10). NTIS, PC A03/MF A01. Order Number DE88016242/JAW.

From 3. international conference on nucleus nucleus collisions; Saint-Malo, France (6 Jun 1988).

Transverse energy and multiplicity distributions from several CERN heavy ion experiments are presented. The large degree of nuclear cascading is shown. Nuclear stopping and the energy density reached in central collisions are discussed. 28 refs., 11 figs.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

52671 **(INIS-SU—51, pp 12-15) Muon emission in prompt fission of uranium nuclei by muons.** Belovitskij, G.E.; Baranov, V.N.; Petizhan, K. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij; Shvejtsariya, Villigen, SIN). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

Angular and energy distributions and the probability of emission of conversion muons emitted during prompt fission of uranium nuclei by muons are obtained for the first time. The multipolarity of gamma radiation (Eγ>3 MeV) of fragments is determined. 10 refs.; 3 figs.; 1 tab.

52672 **(JAERI-M—88-065, pp 10-28) Evaluation of nuclear data for heavy nuclides.** Nakagawa, Tsuneo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

For JENDL-3, nuclear data of nuclides from Th to Pu were evaluated by members of JNDC Subworking Group on Heavy Nuclides Data. In this presentation, status of the evaluated heavy nuclide data stored in JENDL-3T is given.

52673 **(JAERI-M—88-065, pp 243-245) Basic study on the transmutation of radioactive wastes by photonuclear reactions.** Nakamura, Takashi; Yamadera, Akira; Kase, Takeshi. (Tohoku Univ., Sendai (Japan). Cyclotron and Radioisotope Center). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The mass yield distributions and the nuclear transmutation ratios of /sup 237/Np and /sup 238/U by photofission were measured by using the bremsstrahlung beam of 20-, 30- and 60-MeV energies.

52674 **(JAERI-M—88-065, pp 317-329) Evaluation of the fission cross section for U-233 and comparison with that for U-235.** Matsunobu, Hiroyuki. (Sumitomo Atomic Energy Industries, Ltd., Tokyo (Japan). Tokyo Office). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The fission cross section for U-233 was reevaluated in the energy range from 10 keV to 20 MeV, as a part of works for JENDL-3. This revise was performed on the basis of the recent experimental data published after 1982 in which JENDL-2 was released, and using the fission cross section of U-235 which was obtained by simultaneous evaluation for JENDL-3. Especially, the data of fission cross section ratio of U-233 to U-235 which were measured in Tohoku University in 1985 and 1987, were taken into account in the energy range from 200 keV to 7 MeV.

52675 **(JAERI-M—88-065, pp 357-364) Measurements of fast neutron induced fission cross sections of actinide nuclides.** Iwasaki, T.; Karino, Y.; Manabe, F.; Baba, M.; Matsuyama, S.; Hirakawa, N. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

A short introduction is given for recent works on fission cross section measurements at Tohoku University. The technical developments and the measurements using the techniques are described for 1. absolute fission cross sections of /sup 235/U, and 2. fission cross section ratio of /sup 233/U and /sup 239,240,242/Pu relative to /sup 235/U.

52676 **(JAERI-M—88-065, pp 476-485) Expert system for estimation of uncertainty on experimental nuclear data.** Uenohara, Yuji; Tsukamoto, Mitsuhaya; Mori, Toshiya; Kihara, Mitsuru; Kanda, Yukinori. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

We tried to design and expert system for evaluation of the systematic errors. The knowledge base and inference engine of the expert system are written in the computer programing language LISP. The systematic errors of /sup 238/U(n,f) cross section data in EXFOR file were evaluated for an example.

52677 Ratio of the prompt fission neutron spectrum of /sup 239/Pu to that of /sup 235/U. Sugimoto, M.; Smith, A.B.; Guenther, P.T. (Japan Atomic Energy Research Institute, Tokai, Ibaraki (JP)). *Nuclear Science and Engineering;* 97: No. 3, 235-238(Nov 1987).

The prompt fission neutron spectrum resulting from /sup 239/Pu fission induced by ~0.55-MeV incident neutrons is measured from 1.0 to 10.0 MeV relative to that of /sup 235/U fission induced by the same incident energy neutrons. The measurements employ the time-of-flight technique. Energy-dependent ratios of the two spectra are deduced from the measured values. The experimentally derived ratio results are compared with those calculated from ENDF/B-V (revision 2) and with results of recent microscopic measurements. Using the ENDF/B-V /sup 235/U Watt parameters for the /sup 235/U spectrum, the experimental measurements imply a ratio of average fission spectrum energies of /sup 239/Pu//sup 235/U = 1.045 +- 0.003, compared to the value 1.046 calculated from ENDF/B-V (revision 2).

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 52533, 52573, 52574, 52581, 52599, 52615, 52618, 52619, 52620, 52621, 52622, 52630, 52637, 52637, 52645, 52660, 52667, 52677

52678 (AD-A—193856/2/XAB) Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser. Quarterly technical progress report, 1 October-31 December 1987. Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications). Jan 1988. 62p. (GRL—8703). NTIS, PC A04/MF A01.

Recent approaches to the problem of the gamma-ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long wavelength radiation. At the nuclear level, the storage of energy can approach tera-Joules per liter for thousands of years. This report focuses upon the nuclear analog of the optical double resonance methods which produced much of the data base at the molecular level that was of such essential use in the development of conventional lasers. Applied most recently to the study of levels which might be used in dumping isomeric populations into freely radiating states, it produced an unexpected result of major importance. In several test isotopes, a class of extremely useful states was discovered that could radiatively couple to both normal and isomeric states of a nucleus spanning large changes of angular momentum. Achievements culminated in the demonstration of the dumping of population of the first candidate for a gamma-ray laser. One of the least attractive of the isomers because of a large change in angular momentum of 8 h-bar ^{180}Ta/sup m/ was the only one of the candidates available in milligram quantities. Pumped with the bremsstrahlung from a medical linear accelerator having its maximum output near 2 MeV, an astonishingly large cross section of 40,000 was found on the scale where unity results in a large yield.

52679 (CNIC—00063) Approximate treatment for double-differential spectrum of secondary particle in light nuclear reactions. Zhang Benai; Mo Junyong; Du Xiangwan; Liu Guanghua; Du Shuhua; Li Manli. (Inst. of Applied Physics and Computational Mathematics., Beijing (China)). (China Nuclear Information Centre, Beijing, BJ). 1987. 10p. (In Chinese). (IAPCM—0005). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704088/JAW.

The energy-angular double-differential spectrum of secondary particle in light nuclear reactions is closely connected with reaction mechanisms, and is quite useful to nuclear technology applications. In this paper an approximate treatment on the spectrum based on nonrelativistic kinetic theory and collision theory is proposed. As its application, three kinds of spectra are investigated corresponding to the three mechanisms direct break-up, two-step cascade and quasi-free scattering. The related analytic expressions are derived, which can be straightforwards calculated. This approach has been shown to be useful and practicable in actual calculations.

52680 (CONF-880639—4) Understanding the structure of nuclei at finite temperatures. Baktash, C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015570/JAW.

From International conference on contemporary topics in nuclear structure physics; Cocoyoc, Mexico (9 Jun 1988).

The purpose of this commentary is to briefly review several works on nuclear structure and to enumerate a few of the difficulties encountered in the interpretation of the experimental results. To be brief, comments are confined to the studies in the particle-bound regime, i.e., a temperature range of $T \leqq 1$ MeV. Among the interesting topics to be addressed in this temperature range are the question of thermal fluctuations, and the variations of the pairing correlations, shape parameters, nuclear collectivity, and rotational damping width with spin and excitation energy.

52681 (DOE/ER/10397—8) Theory of photon and electron induced reactions: Progress report, July 1, 1986-June 30, 1987. Onley, D.S.; Wright, L.E. (Ohio Univ., Athens (USA). Dept. of Physics and Astronomy). Jul 1988. Contract AC02-79ER10397. 8p. NTIS, PC A02. Order Number DE88014028/JAW.

During the third year of our three-year contract from the Department of Energy, we have made considerable progress or have completed our studies on the following aspects of the general investigation of electron and photon induced reactions; photo- and electro-production of mesons; the radiation tail accompanying elastic electron scattering and pair production; studies involving relativistic shell model; and electrofission coincidence angular distributions. We will report on each of these developments in this paper.

52682 (GSI—88-28-Prepr.) Collisions between heavy nuclei near the barrier. Henning, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). May 1988. 7p. (CONF-8804186—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754648/JAW.

From 23. Zakopane school on physics; Zakopane, Poland (16 Apr 1988).

Detailed information has recently become available on the reaction behavior in very heavy nuclear systems close to the Coulomb barrier. Starting from an experimental study of the distribution of the reaction strength above and below the barrier, the dominant reaction channels of quasi-elastic and strongly-damped processes are examined. With decreasing incident energy, the sub-barrier collisions are increasingly dominated by quasi-elastic processes. From the division of internal excitation energy, new information is obtained on the nature of the dissipative processes.

52683 (INDC(NDS)—192/L) Covariance methods and practices in the field of nuclear data. Proceedings of an IAEA specialists' meeting held in Rome, Italy, 17-19 November 1986. Piksaikin, V. (ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Nuclear Energy Agency, 75 - Paris (France)). Jan 1988. 118p. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

This document contains the 14 invited papers presented at the quoted meeting and summarizes the conclusions and recommendations that arose from the discussions during this meeting. Special emphasis was given to the treatment of correlated neutron nuclear data in fission and fusion reactor applications including computations related to neutron dosimetry and neutron spectra, fission-product yield data, and evaluated nuclear data files. (author). Refs, figs and tabs.

52684 (INDC(NDS)—192/L, pp 59-65) **Covariances in the REAL-84 exercise.** Zijp, W.L.; Szondi, E.J. (Netherlands Energy Research Foundation, Petten; Budapesti Mueszaki Egyetem (Hungary)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

After an introduction on the contents and scope of the REAL-84 exercise the role of covariance information in this exercise was discussed. Covariance matrices can be singular, and the positive definite character is not guaranteed. The effective rank (according to some slightly different definitions) could be much lower than the number of groups determining the dimensions of the matrix. Owing to reasons of numerical precision in the calculations correlation matrices are preferred to covariance matrices. (author). 3 refs, 1 fig., 5 tabs.

52685 (INDC(NDS)—192/L, pp 68-71) **Evaluating nuclear data uncertainty: Progress, pitfalls, and prospects.** Peelle, R.W. (Oak Ridge National Lab., TN (USA)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

The reasons for including variance-covariance information in evaluated nuclear data files are reviewed. Accomplishments and obstacles in meeting these needs are identified. The capability to develop and utilize evaluated cross-section covariance files has been largely demonstrated, but comprehensive files of soundly based covariance data remain to be evaluated and not all types of cross-section data have yet been included. The status of the ENDF-VI covariance formats is discussed. Priorities are suggested for further development. Most effort should be concentrated to fully develop the capability to estimate the nuclear data uncertainties in quantities calculated for a broad energy spectrum. (author). 13 refs, 2 figs.

52686 (INDC(NDS)—192/L, pp 98-101) **Covariances of nuclear model parameters generated from experimental information.** Kanda, Y.; Uenohara, Y. (Kyushu Univ., Fukuoka (Japan). Dept. of Energy Conversion Engineering). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

Bayesian methods have been applied to estimate level density parameters and optical model parameters from experimental data of cross sections and emitted-particle spectra. The level density parameters for 17 nuclides and optical model parameters for n, p and α and their covariances have been obtained from 13 kinds of experimental data. The results of the estimated cross sections, parameters and covariances are presented. (author). 9 refs, 3 figs.

52687 (INIS-mf—11763) **Calculations on precompound reactions with alpha particles, A(α,α')X, at incident energies around 500 MeV.** Rittershausen, W. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1987. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754326/JAW.

The model of Chiang et al. (1980) for nucleon induced precompound reactions, a generalization of the Glauber theory to lower energetical processes, was extended to heavier projectiles the elementary differential cross section of which may furthermore (at fixed incident energy) depend on the momentum transfer. The so modified model was applied to reactions of the type A(α,α')X at an incident energy of about 100 MeV/nucleon, excitation energies of the nucleus in the range 6 to 60 MeV, and for scattering angles from 3 to 6/sup 0/. Thereby the Glauber coefficients were determined by means of the optical potentials known for the treated experiments. Local nucleon momentum distributions in the target nucleus were taken from calculations of Durand et al. (1982). The momentum distributions of the alpha particles after the first α-N collision were both for normalously and for homogeneously distributed nucleon momenta calculated analytically. The distributions after the second collision were determined by folding. For the control of these results and for the eventual calculation of the distributions after more than two collisions a Monte Carlo routine was written. The additional deviation of the alpha particles in real-valued potentials of the target nucleus were regarded. The results in which no free parameter occurs agree quite well in the shape with measured data. In one case it is also valid for the absolute quantities.

52688 (INIS-mf—11770) **Gross properties of nuclei and nuclear excitations. Proceedings.** Feldmeier, H. (ed.). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1988. 328p. (CONF-880161—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88754329/JAW.

From 16. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (18 Jan 1988).

These proceedings contain the articles presented at the named workshop. They are concerned with the application of the results from high-energy physics to nuclear structure calculations, thermodynamics of nuclear matter, and kinetics of heavy ion reactions with special regard to relativistic processes. (HSI).

52689 (INIS-SU—9/A, pp 159-164) **Blokhintsev fluctuation model and experimental study on JINR synchrocyclotron.** Komarov, V.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

Experimental works initiated by Blokhintsev fluctuation model are reviewed. In 60-th proton elastic backscattering by /sup 2/H,/sup 3/He, /sup 4/He, /sup 6/Li nuclei in the initial energy range from 0.1 to 1.0 GeV was investigated. In the late 60-th and beginning of 70-th quasielastic knocking out of the fragments from the nuclei in kinematics close to kinematics of elastic scattering on JINR synchrocyclotron was studied. The investigations were decisive in developing ideas on the mechanism of nuclear processes with high momentum transfer to the nucleus or its substructures - fluctons.

52690 (INIS-SU—9/A, pp 150-158) **Blokhintsev fluctons and relativistic nuclear physics.** Efremov, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

The paper concerning relativistic nuclear physics beginning from 1957 have been reviewed. D.I. Blokhintsev in his work "on fluctuations of nuclear matter density" laid the foundations for this new trend. The subject of relativistic nuclear physics - rigid processes with participation of nuclei and nuclear forces at the distances compared with nucleon size. Cumulative fenomena are studied as that of producing C secondary particles on A nucleus in inclusive process B+A=C+X beyond the kinematic range limits, attained in collisions with one immovable nucleus nucleon. The hypothesis is set up, that Blokhintsev fluctons cause cumulative particles. The results of studying this fenomenon:"nuclear skaling", universal character of all cumulative particle spectrum shape, specific A-dependence of cross-section, ratio of cumulative meson yields testifying to quantum nature of this phenomenon.

52691 (INIS-SU—51, pp 22-24) **Parameters of p-wave part of pion-nucleus optical potential.** Efrosinin, V.P.; Zaikin, D.A.; Osipchuk, I.I. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

The mechanisms of p-wave absorption of stopped π-mesons by atomic nuclei are described. Two-nucleon parameters of p-wave part of optical pion-nuclear potential are calculated. 9 refs.; 1 fig.; 1 tab.

52692 (INS—671) **Coulomb-assisted hybrid bound states of Σ/sup -/ in medium nuclei populated by K/sup -/ absorption at rest.** Yamazaki, T.; Hayano, R.S.; Morimatsu, O.; Yazaki, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Feb 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754550/JAW.

To seek for a possible way to determine Σ/sup -/-nuclear interactions even in the case of a shallow nuclear potential and/or a strong Σ-Λ conversion, theoretical discussions are given on the formation of Coulomb-assisted hybrid bound states of Σ/sup -/ in nuclei, where the short-range strongly absorptive potential coexists with the long-range Coulomb potential. Bound states of hybrid character of medium widths are predicted, which can well be populated in (stopped K/sup -/, π/sup +/) reactions.

52693 (INS—672) **Extraction of dynamical collective subspace for large-amplitude collective motion. Application to simple solvable model.** Muramatsu, Kazuhiro; Sakata, Fumihiko; Marumori, Toshio. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1988. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754551/JAW.

A quantum theory appropriate for describing global aspects of nuclear collectivity is applied to a simple four-level system with pairing interaction. One of the basic ingredients of the theory is how to select a dynamical representation specific for large-amplitude collective motion under consideration out of an infinite number of unitary-equivalent representations. Physical meaning of dynamical collective subspace associated with the dynamical representation is elucidated by using the simple model Hamiltonian.

52694 (JINR—D-1,2-86-668, pp 38-47) **EMS effect and QCD evolution of three-quark picture of a nucleon.** Grigoryan, L.A.; Shakhbazyan, V.A. (Erevanskij Fizicheskij Inst. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

EMC effect is investigated using QCD approach based on effect of nucleon swelling in nucleus and three-quark structure of nucleon. A model, taking account of exchange of color objects (valent quarks, gluons, quark-antiquark sea interactions) and resulting in increase of nuclear nucleon size in the range of Bjorken variable values $0.25 \leqq x \leqq 0.65$, is briefly described. Comparison of experimental data for dependences of deuterium and iron structure functions (SF) (as well as their R ratios) on transferred momentum square and fixed values of x variable is carried out. The calculated values for SF (D) and SF (Fe) and available experimental data are compared. It is noted that the suggested approach permitted to trace the effects of nucleon swelling in nuclei and to show different character of valon distribution in nucleons and nuclei. 29 refs.; 4 figs.

52695 (JINR—D-1,2-86-668, pp 55-57) **Color oscillations of nucleons in a nucleus.** Petrov, V.A.; Smirnov, A.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Possibility of nucleus description as an object consisting of quarks and gluons is considered. A model of two-nucleon interaction in a nucleus is presented and analytical expressions for the nucleus nucleon ground state wave functions and also for nuclear nucleon structure functions are obtained. The carried out analysis shows that the suggested model permits to express the nucleus structure functions at quark level only by means of nucleon and Δ-isobaric degrees of freedom.

52696 (JINR—D-1,2-86-668, pp 6-16) **Hard processes on nuclei in a model of fluctons with rescaling.** Zotov, N.P.; Saleev, V.A.; Tsarev, V.A. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; AN SSSR, Moscow. Fizicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

In the framework of a model of fluctons with rescaling the process of lepton deep inelastic scattering (DIS) and cumulative production of particles (pions, protons, lepton pairs, etc.) on various nuclei are considered. To explain experimental data of EMC effect the behaviour of structure functions (SF) of /sup 4/He, /sup 9/Be, /sup 12/C, /sup 27/Al, /sup 40/Ca, /sup 56/Fe, /sup 108/Ag, /sup 197/Au nuclei in cumulative region (where the Bjorken variable $x=1.3$ is investigated, as well as dependences of carbon nucleus structure function on the value of x or transferred momentum square, taking into account the effects of rescaling, nucleon Fermi-motion and impurity of two-nucleon fluctons. Production of a massive lepton pair in the process pA ->ll-bar + X and of photon with a large transverse momentum in the process pA -> γ + X, as well as photoproduction of J/PSI (particles in the model of photon-gluon coalescence in kinematic region, corresponding to the values of nuclei SF arguments $X \leqq 0.6$, are discussed. It is pointed out that consideration according to the approach suggested of production processes of lepton pairs and direct photons in pA-interactions, and also photoproduction of J/PSI particles on nuclei, provide results that differ from the results on similar processes taking place on free nucleons. 36 refs.; 12 figs.; 1 tab.

52697 (JINR—D-1,2-86-668, pp 27-37) **Quark cluster model for high energy lepton-nucleus and hadron-nucleus interactions.** Vary, J.P.; Harindranath, A. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1987. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The description of lepton-nucleus and hadron-nucleus interactions in the framework of cluster quark model (CQM) is considered. Analysis of experimental data, obtained for deep inelastic scattering of electrons on /sup 3/He nucleus is carried out and critical radius of R/sub c/ for 3, 6, 9-quark clusters is determined. Predictions of CQM in the region of the Bjorken variable $x>1$ for nuclear structure functions are tested. The Drell-Yan (DY) processes for proton-nucleus, pion-nucleus interactions in the framework of CQM are discussed and the data obtained for differential cross sections pN-, PID-, PIFe-interactions and their ratios for various nuclei are compared with predictions of other models. It is pointed out that the description of sea quark and antiquark distributions in nuclear processes in DY model is as reliable as in CQM. 31 refs.; 4 figs.

52698 (JINR—D-1,2-86-668, pp 48-54) **Towards probing superdense nuclear matter in lepton-nucleus collisions.** Frankfurt, L.L.; Strikman, M.I. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

In the paper following questions are considered. Two options for the EMC effect at $x < 0.2$ (valence versus sea quark shadowing and antishadowing phenomena); the EMC effect at x {similar←to} 0.5 and related effects; the $x > 1$ physics as a direct probe of superdense nuclear matter. It is concluded in the next 10 years the leptonic reactions would become a fine microscope for investigation of superdense (up to 1 GeV/cm/sup 3/) configurations in nuclei especially if combined with experience accumulated in related γ, h reactions with production of the cumulative particles. 2 refs.; 1 fig.; 1 tab.

52699 (JINR—D-1,2-86-668, pp 243-250) **Specific entropy and the light particle yield in relativistic heavy ion collision.** Schulz, H.; Roepke, G. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic); Rostock Univ. (German Democratic Republic)). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The study of the entropy production in relativistic heavy ion collisions permits to investigate the behaviour of matter far from the ground state. This is because the entropy is assumed to grow rapidly when the nucleons make their collisions and to remain almost constant in the expansion phase when the interaction between the constituents of the nuclear fireball ceases. Cascade and hydrodynamical model calculations are capable of describing the complicated collision dynamics and therefore, can provide with a window at an early stage of the reaction where matter was still hot and dense. The entropy value is calculated by means of the independent particle approximation, i.e. one introduces a probability that a certain single-particle state or a certain phase space volume is occupied in the Fermi gas approximation. The cascade approach permits to distinguish between the spectators and participants and allows to calculate their disintegration process seprately. It could well be that the cluster yield as measured by the 4π detector could turn out to be somewhat lower forlow multiplicity events when experimentally a clear distinction between spectator and participant matter would be possible. 17 refs.; 2 figs.

52700 (JINR—D-1,2-86-668, pp 334-346) **Theory of anomalons.** Kim, Y.E. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The new theory of "anomalous" is parameter-free and gives a consistent qualitative explanation of the "anomalon" data for the two-component Z=2 case. Additional theoretical calculations of the mean free path λ/sub e//sup calc/(x), for other Z=2 "anomalous projectile fragments" data will be published. A generalization to the multi-component cases is straightforward and will be given. 21 refs.; 3 figs.

52701 (JINR—D-1,2-86-668, pp 347-358) **Baryon multiplicity distribution in nuclear matter produced by heavy ion collisions at stopping energy regime.** Iga, Y.; Hamatsu, R.; Yamazaki, S.; Sumiyoshi, H. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). 1987. NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

The Monte Carlo event generator (MCMHA) for high energy p-A collisions, which is developed on the basis of the multichain model (MCM), is introduced. Based on the results of MCMHA, the probability, p/sub s/, is obtained of the incident proton losing more than half of its incident rapidity in p-A collisions. 10 refs.; 3 figs.

52702 (JINR—D-1,2-86-668, pp 58-64) **Interpretation of the EMC-SLAC effect and its A dependence in self-consistent approach without exotics.** Nagornyj, S.I.; Kasatkin, Yu.A.; Kirichenko, I.K.; Inopin, E.V.; Kuprikov, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Possibility of interpretation of the self-consistent description of the EMC-SLAC effect A-dependence on the basis of standard representation of nuclear structure is discussed. Different models suggested for description of the EMC effect satisfying the following requirements: conservation of energy-momentum; conservation of baryon charge; self-consistent description of static, spectroscopic an dynamic characteristics of nucleus; account of space-time picture of the process; absence of free parameters in description of EMC effect A-dependence, are discussed. Results of self-consistent calculations of structure functions for d, /sup 12/C, /sup 56/Fe, /sup 108/Ag are presented. The carried out consideration permitted to conclude that EMC effect and its A dependence are not critical to selection of meson or quark phenomenology and the latter is not applied as exotics at the background of usual description. 9 refs.; 3 figs.

52703 (JINR—D-1,2-86-668, pp 65-71) **Relativistic wave functions and relations between the structure functions and the moments of composite systems.** Linkevich, A.D.; Savrin, V.I.; Sanadze, V.V.; Skachkov, N.B. (Novopolotskij Politekhnicheskij Inst. (Byelorussian SSR); Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Tbilisskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

To describe EMC-effect relations between the structure functions (SF) of a nucleus and constituent nucleons and also the moments of investigated SF are studied. To take account of exponential with respect to 1/Q/sup 2/ corrections an expression for SF nucleus Nachtman moments in terms of nucleon SF Nachtman moments and nucleus wave functions is evaluated. Relation between nucleus SF and SF constituent nucleon is considered. It is noted that obtained expressions are suitable for description of contribution of different mechanisms to EMC effect. 8 refs.

52704 (JINR—D-1,2-86-668, pp 148-168) **Effects of color screening in hadron diffraction scattering on nuclei.** Kopeliovich, B.Z.; Lapidus, L.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. (In Russian). (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Lately hadron-nuclear interactions are widely used to receive information about the nature of nuclear forces, space-time pattern of strong interactions and etc. Often this information is unique. In this case the Glauber-Sitenko theory is the "basis" proceeding from which one can discuss any effects. Certain illustrations of such a fruitful approach are reviewed. So, reliable confirmation of hadron interaction cross section dependence on the sizes predicted by QCD is obtained for the first time in the meson quasifree charge-exchange reaction on nuclei. Specific for QCD long-range interaction in rapidities occurs in A dependence of inclusive spectra in three- reggeon region. One can judge about the size of six-quark bag in a deuteron according to the value of pd-scattering total cross section deviation from the predicted Glauber-Sitenko model. 30 refs.; 13 figs.

52705 (JINR—R-2-87-417) **On a problem of description of the /sup 1/H(d,p)X reaction at deuteron relativistic energies.** Azhgirej, L.S.; Ignatenko, M.A.; Razin, S.V.; Yudin, N.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703390/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

Calculations of the momentum spectra of protons, emitted both with large and zero transverse momenta in the /sup 1/H(d,p)X reaction (the detection angles of protons are 0.139 and 0 rad, respectively), have been performed for different reaction mechanisms. In the case of the large transverse momenta the graphs with the excitation of the pion degrees of freedom on the whole yield only minor corrections to the results obtained in the hard collision model. On the contrary, for zero angles of the secondary proton emission the direct deuteron fragmentation and the mechanism with the excitation of the pion degrees of freedom turns out to give approximately the same contributions in the momentum interval of secondary protons 0.1-0.3 GeV/c (in the rest frame of the dueteron), and the possibility of the interference of the amplitudes for

different reaction mechanisms should be taken into account. 24 refs.; 5 figs.

52706 **(JINR—R-4-87-156) Description of one-particle nuclear potentials and densities by the inverse problem method.** Kartavenko, V.G.; Medler, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. (In Russian). (CONF-8704221—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703930/JAW.

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

Submitted to the journal Izv. AN SSSR, Ser. Fiz.

Analytic description is constructed for density profiles and potentials of one-dimensional nuclear layers by the inverse mean field method. It is shown that this method well reproduced the calculations of the density profiles made by the Hartree-Fock method. Self-consistent potentials are well reproduced in the internal region of a nucleus, but in the asymptotic region the agreement gets worsen. Calculations of layers were carried out in different external fields. It is shown tht this method allows one to construct, with the use of one-particle spectrum, not only the ground state but also various excited states of one-dimensional nuclear systems (compressed nuclei, nuclei with two centres, etc.). 11 refs.; 4 figs.

52707 **(JINR—R-7-87-482) Tunneling in the decay and fusion of complex nuclei.** Tarakanov, A.V.; Shilov, V.M. (Saratovskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703411/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The total penetrability at energies below the Coulomb barrier is shown to be asymmetric in the framework of the coupled-channel boundary-condition model that takes into account the internal structure of the colliding nuclei. The increase of the tunneling probability for the decay reactions is small as compared with the single-channel case. It is shown that the consideration of the initial excited states of decay fragments is important. 14 refs.; 3 figs.

52708 (KURRI-TR—291, pp 6-11) **Improvements of mass formula and β-decay gross theory.** Tachibana, Takahiro. (Waseda Univ., Tokyo (Japan). Science and Engineering Research Lab.). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

The nuclear mass greatly decreases when the number of protons Z and neutrons N is simultaneously equal to a magic number (mutual support of magicities). The mass also tends to decrease due to deformation as both N and Z are away from the magic numbers (mutual support of deformations). These two effects are introduced to a nuclear mass formula containing a constant-type shell term to derive a new formula. The mass excess is expressed by a sum of three parts, i.e. gross part, even-odd part and shell part. The gross part, which represents the general nature, consists of two rest mass terms and a coulomb term. The even-odd part is of a typical form with a correction term. The shell part consists of a proton shell term, neutron shell term, third term expressing the two mutual support effects, and fourth term representing a decrease in coulomb energy due to deformation of the nucleus. The improvements made in the β-decay gross theory are associated with the single particle intensity function D/sup 0//sub GT/(E,ϵ). They are intended for: (1) reproducing the peak that accounts for about a half of the Gamow-Teller intensity, which has recently been found in (p,n) reactions at energies above the isobaric analogue state and (2) explaining the other half by an exponential-type D/sup 0//sub GT/(E,ϵ). (Nogami, K.).

52709 (KURRI-TR—291, pp 30-35) **Contribution of short-lived nuclides to decay heat.** Katakura, Jun-ichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Apr 1987. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780145/JAW. (CONF-8612156—).

From 3. specialist research meeting on measurements of short-lived isotopes; Kumatori, Japan (17 Dec 1986).

Comments are made on the calculation of decay heat, centering on evaluation of average decay energy. It is difficult to obtain sufficiently useful decay diagrams of short lived nucleides. High-energy levels are often missing in inferior decay diagrams, leading to an overestimation of the intensity of beta-rays at low-energy levels. Such an overestimation or underestimation due to the inferiority of a decay diagram is referred to as pandemonium effect. The pandemonium effect can be assessed by means of the ratio of the measured energy of the highest level of the daughter nuclide to the Q/sub β/-value of the beta-decay. When a satisfactory decay diagram cannot be obtained, the average decay energy has to be estimated by theoretical calculation. The gross theory for beta-decay proposed by Yamada and Takahashi is employed for the calculation. To carry out the calculation according to this theory, it is required to determine the value for the parameter Q/sub 00/, the lowest energy of the daughter nuclide that meets the selection rule for beta-decay. Currently, Q/sub 00/ to be used for this purpose is estimated from data on the energy of the lowest level found in a decay diagram, even if it is inferior. Some examples of calculation of decay heat using the average beta- or gamma-ray energy are shown and compared with measurements.

52710 **(LA-UR—88-1753) The GNASH preequilibrium-statistical nuclear model code.** Arthur, E. D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 51p. (CONF-880298—1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88014474/JAW.

From Applied nuclear theory and nuclear model calculations for nuclear technology applications; Trieste, Italy (15 Feb 1988).

The following report is based on materials presented in a series of lectures at the International Center for Theoretical Physics, Trieste, which were designed to describe the GNASH preequilibrium statistical model code and its use. An overview is provided of the code with emphasis upon code's calculational capabilities and the theoretical models that have been implemented in it. Two sample problems are discussed, the first dealing with neutron reactions on ^{58}Ni. the second illustrates the fission model capabilities implemented in the code and involves n + ^{235}U reactions. Finally a description is provided of current theoretical model and code development underway. Examples of calculated results using these new capabilities are also given. 19 refs., 17 figs., 3 tabs.

52711 **Cohen, Picklesimer, and Van Orden reply.** Cohen, T.D.; Picklesimer, A.; Van Orden, J.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **61**: No. 12, 1428-1428(19 Sep 1988).

This comment concerns medium modified form factors, relativistic dynamics, and the (e,e'p) reaction . Off-shell current operators, gauge invariance of the current operators of the (e,e'p) reaction, and the breakdown of the impulse approximation due to discrepencies between calculated bound-state momentem profiles and the measured momentum distribution are considered. (AIP)

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 50876, 50878, 50884, 51180, 51183, 51188, 52946

52712 **(CEA-R—5451) Non isotropic radiation transfer.** Munier, A. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Jun 1988. 17p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754949/JAW.

A model for radiation transfer in a non isotropic medium is introduced, based on a tensor representation for the opacity, and

which leads to an explicit expression for the Eddington tensor. The equations are compatible with a P 1 method in the isotropic limit.

52713 **(CNIC—00064) Calculations of neutron energy deposition in light materials.** Chen Yunshan; Zhang Benai. (Inst. of Applied Physics and Computational Mathematics, Beijing (China)). (China Nuclear Information Centre, Beijing, BJ). 1987. 8p. (In Chinese). (IAPCM—0006). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704089/JAW.

The neutron energy deposition in media is more important in practical applications of nuclear engineering and technology. As a basis of KERMA factor calculation, this physical quantity is widely applied in the studies of nuclear heating and radiation effects. In this paper we propose a kinematic approach to calculate neutron energy deposition in the light materials. Related formulas given here can be used to treat most kinds of nuclear reactions such as elastic and inelastic scattering, absorption and few-body processes. Some calculated results for light nuclei are given as well.

52714 (CONF-760202—, pp 769-772) **Determination of secondary barrier thickness for cobalt-60 scattered radiation.** Syed, I.B.; Hanc, R.P. (Wesson Memorial Hospital, Springfield, MA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The method of computing primary and secondary protective barrier thicknesses for a Cobalt-60 Teletherapy Unit has been described in NCRP Report No. 34. This report has Tables and Transmission Curves for computing the primary and secondary protective barrier thickness. There was no difference in the computed values of shielding thickness obtained by the Table and the Transmission Curve in the case of the primary protective barrier. However, there is a significant difference, as much as 47%, in the computed values obtained by the Table and the Transmission Curve for the secondary protective barrier thickness for scattered radiation. The difference in the source skin distance and the field size used in the generation of the Table and the Transmission Curve appear to be the main reasons for the discrepancies.

52715 (CONF-760202—, pp 773-777) **Discrepancies in the determination of primary and secondary barrier thicknesses for diagnostic radiologic installations.** Syed, I.B. (Wesson Memorial Hospital, Springfield, MA (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The discrepancies in the determination of primary and secondary barrier thicknesses for diagnostic radiologic installations, using the NCRP (National Council on Radiation Protection and Measurements) Report No. 34 Table and Transmission Curve have been shown in this paper. In the case of primary protective barrier, the difference could be as much as 13 percent. In the case of the secondary protective barrier, the difference could be as much as 200 percent and more.

52716 (CONF-760202—, pp 778-780) **Leakage radiation calculations for diagnostic X-ray machines.** Sayeg, J.A. (Univ. of Kentucky Medical Center, Lexington (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A component of radiation in shielding calculations least understood by the Health Physicist is that due to leakage from the x-ray tube housing. Present textbooks in Health Physics assume an on time which appears to be excessive from an operational viewpoint. Confusion seems to arise from the fact that the workload is expressed in mA-min per week whereas the regulation for leakage is stated in terms of mR per hour. It is the purpose of this note to present a more informative method based upon the heat rating capacity of the anode and which is consistent with the workload expressed in mA-min per week. This treatment is in agreement with the formulation given in NCRP Report No. 34. Nominal leakage values have been summarized in tubular form for different combinations of heat rating limitations and maximum kilovoltage.

52717 (INDC(NDS)—192/L, pp 54-58) **Covariance files for neutron spectra and fission yield evaluations with notes on Monte Carlo sensitivity calculations.** Weaver, D.R. (Birmingham Univ. (UK). Dept. of Physics). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

Three areas of work are described: the production of covariance error files associated with the unfolding of experimental results from measurements of delayed neutrons from fission; progress in evaluation of fission yields and the implications for covariance analysis; and the production of a correlated tracking option in the Monte Carlo code MORSE and its use in the production of sensitivity matrices. (author). 10 refs, 3 figs.

52718 (INDC(NDS)—192/L, pp 66-67) **Nuclear data need for the covariance information used in the neutron spectrum adjustment.** Szondi, E.J.; Zsolnay, E.M. (Budapesti Mueszaki Egyetem (Hungary). Egyetemi Reaktor). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

52719 (INIS-SU—9/A, pp 177-183) **Ultracold neutrons heating theory and its experimental testing.** Plakida, N.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

A theory of ultracold neutron (UCN) heating for a case of impurity hydrogen scattering is presented in brief. In comparison of the theory and the latest experiments only those are chosen that are decisive in confirmation of the hypothesis on defining role of hydrogen in UCN heating, UCN inelastic scattering on the wall surface is considered. Theoretical estimation of UCN loss coefficient is carried out. A direct confirmation of hypothesis on decisive role of hydrogen (hydrogen contamination of the walls of containing vessels) in UCN heating is obtained.

52720 (JAERI-M—88-065, pp 162-190) **Shielding benchmark test for JENDL-3T.** Hasegawa, Akira. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The results of the shielding benchmark tests for JENDL-3T (testing stage version of JENDL-3), performed by JNDC Shielding Sub-working group, are summarized. Especially, problems of total cross-section in MeV range for O, Na, Fe, revealed from the analysis of the Broomstick's experiment, are discussed in details. For the deep penetration profiles of Fe, which is very important feature in shielding calculation, ASPIS benchmark experiment is analysed and discussed. From the study overall applicability of JENDL-3T data for the shielding calculation is confirmed. At the same time some problems still remained are also pointed out. By the reflection of this feedback information applicability of JENDL-3, forth coming official version, will be greatly improved.

52721 (JAERI-M—88-065, pp 263-278) **Measurement of leakage neutron spectra from various sphere piles with 14 MeV neutrons.** Ichihara, Chihiro; Hayashi, S.A.; Kobayashi, Katsuhei; Kimura, Itsuro; Yamamoto, Junji; Takahashi, Akito; Izumi, Mikio. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

A series of experiment to measure neutron leakage spectra from six different piles is reported. Measured samples include silicon, chromium, manganese, cobalt, copper and niobium. The experiments were performed by using an intense 14 MeV pulse neutron facility OKTAVIAN [1] and a time-of-flight (TOF) technique in the energy range between 100 keV and 15 MeV. The piles were constructed by filling the powder in spherical shells made of stainless steel or ordinary steel. The results were compared with theoritical calculation using one-dimensional transport codes to check the existing data files, ENDF/B-IV and/or JENDL-3T. Generally speaking, JENDL-3T data gave much preferable calculated spectrum to ENDF/B-IV ones did, while ENDF/B-IV data contains several primitive mistakes as to the inelastic-level scattering or (n,2n) cross sections of chromium, manganese, copper and niobium. For copper pile, the calculated spectrum using JENDL-3T data gave satisfactory prediction. However, for silicon and chromium case, the calculated spectra gave overestimation provably due to the error of (n,2n) cross sections. For manganese case, the problem observed in ENDF/B-IV calculation still remained unimproved to some extent.

52722 (JAERI-M—88-065, pp 279-316) **Angle-integrated neutron emission spectra at 14 MeV for Be, C, F, Mg, Al, Si, V, Fe, Cr, Cu, Pb and Bi.** Takahashi, Akito; Sasaki, Yasuhiro; Sugimoto, Hisashi. (Osaka Univ., Suita (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Using measured double differential neutron emission cross sections at 14.1 MeV for 15 to 16 angle-points, angle-integrated neutron emission spectra in the center-of-mass system were deduced for Be, C, F, Mg, Al, Si, V, Fe, Cr, Cu, Pb and Bi. These angle-integrated data are useful to assess partial emission cross sections of elastic, discrete inelastic, continuum inelastic scattering and other reaction channels like (n,2n) given in evaluated nuclear data libraries, e.g., JENDL-3 and ENDF/B-IV. Through comparison between experimental and evaluated emission data, status of JENDL-3T or ENDF/B-IV at 14 MeV has been made clear in this report. Significant improvement has been made by JENDL-3T for most elements except Be and Pb. For Be and Pb, further investigation is needed to improve JENDL-3T. Generally, improvement is needed to reproduce the forward-enhancement of neutron emission in double differential data.

52723 (JAERI-M—88-065, pp 388-398) **Analysis of neutron spectra measurement in concrete assembly using JENDL-3T.** Oishi, Koji; Tomioka, Kazuyuki; Ikeda, Yujiro; Nakamura, Tomoo. (Shimizu Corp., Tokyo (Japan). Inst. of Technology). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

For the verification of JENDL-3T (test version of JENDL-3), the analysis of neutron spectral measurement in concrete using that new data library was applied to the experiment. Comparison with JENDL-2 was also performed as a reference. The result obtained using JENDL-3T was in approximate agreement with experiment in the higher neutron energy range En ≧ 7.3 MeV, but in the lower energy range there remained much room for further investigation.

52724 (JAERI-M—88-065, pp 399-406) **Si-PKA spectra in a Si-SSD bombarded by 14 MeV neutrons.** Yageta, K.; Iwasaki, S.; Sugiyama, K. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

An atempt to measure the PKA's energy spectra for silicon was made using a method in which a silicon detector was used as a sample too. The Si-SSD was bombarded by 14 MeV neutrons and the resulting spectra have been measured in order to compare with the calculated ones using a code developed in this study for the PKA's and charged particles (CP's) with evaluated neutron nuclear data library, ENDF/B-IV. The calculated one globally reproduced the experimental one. However, in detailed inspection, the present conventional model was too simple to compare both spectra. It is necessary to adopt more realistic nuclear models, especially for two-body continuum and three-body reactions, and include some effects such as penetration of the energetic particles and energy loss process of the PKA's at low energy regions, etc.

52725 (JAERI-M—88-065, pp 415-421) **Integral test of neutron cross sections in the JENDL-3T through an analysis on the neutron deep penetration experiment at the ORNL TSF.** Sakurai, Kiyoshi; Ueki, Kohtaro; Kawai, Masayoshi. (Japan Inst. of Nuclear Safety, Tokyo (Japan)). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

ORNL TSF sodium neutron deep penetration benchmark experiment is analysed for integral test of neutron cross sections in JENDL-3T. C/E's of Bonner ball reaction rates are about 1.0 - 1.1. As for neutron spectrum in the energy range 0.1 - 10 MeV, the JENDL-3T slightly overestimates neutron fluxes as like ENDF/B-IV. It is concluded that the JENDL-3T is the most applicable to shielding analysis.

52726 (JAERI-M—88-065, pp 422-428) **Evaluation of secondary gamma-ray production cross sections of iron in the JENDL-3T through an analysis on the 14-MeV neutron penetration experiment of SUS-304 at the ORNL.** Sakurai, Kiyoshi; Ueki, Kohtaro. (Japan Inst. of Nuclear Safety, Tokyo (Japan)). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The 14-MeV neutron penetration experiment of SUS-304 carried out at the ORNL is a typical benchmark problem to evaluate not only a calculational method of fast neutrons but also neutron cross sections and secondary gamma-ray production cross sections, as well. The benchmark experiment was analyzed by the MORSE-CG code with the ENDF/B-IV and the JENDL-3T cross section libraries. The neutron and gamma-ray coupled cross sections were compiled by the RADHEAT-V4 code system.

52727 (JAERI-M—88-065, pp 429-432) **Neutron integral test of graphite cross sections in MeV energy region for the JENDL-3T through an analysis of WINFRITH shielding experiment.** Ueki, Kohtaro; Sakurai, Kiyoshi. (Ship Research Inst., Tokyo (Japan)). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

The neutron integral tests of graphite cross sections in MeV neutron energy region for the ENDF/B-IV, JENDL-2, JENDL-3PR1 and -3T were performed through the Monte Carlo analysis of the graphite shielding experiment at the WINFRITH. The measured values were on the reaction rates of /sup 115/In(n,n') /sup 115m/In, /sup 27/Al(n,α)/sup 24/Na, /sup 32/S(n,p)/sup 32/P, and /sup 103/Rh(n,n')/sup 103m/Rh threshold detectors located in the graphite slabs, so that the experiment on the graphite was good at the integral test of neutron cross sections in MeV energy resion.

52728 (JAERI-M—88-065, pp 467-475) **Prototyping of an expert system for nuclear data evaluation.** Iwasaki, S.; Odano, N.; Takahashi, M.; Kitamura, M.; Sugiyama, K. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

A prototype guidance system for the nuclear cross section calculation has been developed in a 16-bit personal computer. The system was consisted of two main parts: the first part is for selection of the code system, and the second one is for selection of the best input parameters for the selected codes. Priciples of guidance were taken from several literatures and recomendations.

52729 **(JAERI-M—88-076) Neutron cross section libraries for analysis of fusion neutronics experiments.** Kosako, Kazuaki; Oyama, Yukio; Maekawa, Hiroshi; Nakamura, Tomoo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 75p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754568/JAW.

We have prepared two computer code systems producing neutron cross section libraries to analyse fusion neutronics experiments. First system produces the neutron cross section library in ANISN format, i.e., the multi-group constants in group independent format. This library can be obtained by using the multi-group constant processing code system MACS-N and the ANISN format cross section compiling code CROKAS. Second system is for the continuous energy cross section library for the MCNP code. This library can be obtained by the nuclear data processing system NJOY which generates pointwise energy cross sections and the cross section compiling code MACROS for the MCNP library. In this report, we describe the production procedures for both types of the cross section libraries, and show six libraries with different conditions in ANISN format and a library for the MCNP code.

52730 **(JINR—R-3-87-298) SPIRO program for calculation of neutron spin behaviour in magnetic fields.** Oehler, G.; Oehler, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703402/JAW.

Submitted to the journal Wissenschaftliche Zeit.

Influence of variable magnetic fields on the polarization state of the neutron beam is considered in the framework of preparation and interpretation of physical experiments with polarized neutrons. By means of the SPIRO program it is possible to solve the equation of motion of the neutron spin in any macroscopic magnetic field with large accuracy. The test of accuracy of the method is demonstrated in the cases of a constant and a rotating magnetic field. 7 refs.; 4 figs.

52731 **Time-dependent first-flight leakage rates for slabs, spherical shells, and spheres.** Henderson, D.L.; Maynard, C.W. (Univ. of Wisconsin-Madison, Nuclear Engineering and Engineering Physics, 1500 Johnson Drive, Madison, WI (US)). *Nuclear Science and Engineering;* **97**: No. 3, 203-210(Nov 1987).

By making use of the Laplace transform technique, time-dependent first-flight leakage rates from slabs, spherical shells, and spheres with a uniform source distribution and a delta-shaped pulse have been calculated from their steady-state counterparts found in the available literature. Time-dependent solutions for a quadratic source distribution with a delta pulse have been obtained for a slab and a solid sphere. Using the results for a slab and a solid sphere with a uniform source as a Green's function, the case of a constant source emitting neutrons over a time interval Δt is considered.

52732 **Neutron capture cross sections of rhenium from 3 to 1900 keV.** Macklin, R.L.; Young, P.G. (Oak Ridge National Lab., P.O. Box X, Bldg. 6010, Oak Ridge, TN (US)). *Nuclear Science and Engineering;* **97**: No. 3, 239-244(Nov 1987).

The neutron capture cross section of elemental rhenium was measured to neutron energies between 3 and 1900 keV at the Oak Ridge Electron Linear Accelerator time-of-flight facility. A deformed optical model was used to analyze published neutron total cross sections for rhenium and low-energy average resonance parameters for /sup 185/Re and /sup 187/Re. The optical model results were used with reaction theory to calculate radiative capture cross sections for comparison with the present experimental data.

52733 **Neutron slowing down and transport in an infinite medium - II: the scalar flux at large distances/small lethargies.** Cacuci, D.G. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 337-338(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A companion paper has presented a generalized age theory expression for the scalar flux Phi/sup G//sub O/ (x, u) due to a plane isotropic source emitting neutrons in an infinite medium with cross sections that are constant in energy. The range of validity for this generalized age theory expression has also been determined as $p = x/(2u) \leq R(A)$, where R(A), the range of validity, is a function of the scatterer's mass. The purpose of this paper is to present the expression for the scalar flux Phi/sup G//sub O/ (x,u) in the complementary region in phase space, i.e., where $p > R(A)$.

52734 **Improvement of variational nodal transport methods by Lagrange multiplier techniques.** Lewis, E.E. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society;* **55**: 349-350(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

It has been demonstrated in earlier work that nodal transport methods can be formulated through the use of a variational form of the even-parity transport equation. The resulting methods have been used to obtain coarse-mesh solutions to two-dimensional P_1 and P_3 equations in a response matrix form. The formalism preserves neutron balance in each spatial node, while allowing the flux distribution within a node to be treated as a complete polynomial or other finite element like trial function. Subsequently, the method has been formulated as a global functional in which the odd-parity interface conditions appear as Lagrange multipliers. It is shown that the Lagrange multiplier formulation may be used to reduce the number of basis functions used to specify the interface conditions, thereby reducing the dimension of the nodal response matrices without a commensurate loss of accuracy. Specifically, by careful choice of Lagrange multiplier trial functions, one can cut the number of interface conditions by two and still obtain near P_3 accuracy. Moreover, the resulting formalism suffers neither from ray effects nor from the inaccuracies for streaming diagonal to the coordinate directions that have been observed in some nodal transport methods.

52735 **General order nodal transport methods in weighted diamond difference form.** Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 350-352(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

In spite of the demonstrated very high accuracy and computational efficiency of high-order nodal transport methods, their implementation in practical computer codes has been severely limited because of their complicated formalism and final equations. Recently, it was shown that three different approximations to the linear-linear (LL) nodal transport method can be cast in a simple, compact, weighted diamond difference (WDD) form. Because the WDD form is exactly equivalent to some traditional nodal methods (linear nodal and LL) the former was shown to result in solutions that possess the previously established high accuracy of the latter. One of the three nodal methods, the bilinear nodal (BL) method, has been extended to general dimensionality in Cartesian geometry and general order of approximation. In spite of their generality, the final discrete variable equations have a simple compact WDD form in terms of a single spatial weight per dimension per distinct discrete ordinate.

52736 **XY-geometry analysis of an S_2-like synthetic acceleration scheme.** Nowak, P.F.; Adams, M.L. (Univ. of Michigan, Ann Arbor (USA)). *Transactions of the American Nuclear Society;* **55**: 354-355(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A class of synthetic acceleration methods called boundary projection acceleration (BPA) methods has recently been developed for the transport equation. Unlike diffusion synthetic acceleration schemes, which obtain acceleration equations by invoking P_1 approximations, BPA methods obtain acceleration equations by projecting the transport angular flux onto a coarse angular function space only on cell boundaries. Different BPA schemes are obtained by varying the projection technique and/or the coarse function space. The BPA methods are very general; they are applicable to virtually any transport discretization regardless of geometry or

mesh shape. However, since there is no a priori guarantee that any acceleration scheme will work, each BPA method should be analyzed and tested (in the geometry of interest) before being trusted. This analysis and testing has been done in slab geometry for several BPA methods and a variety of spatial discretizations; results indicate that the methods are stable and very fast. Currently in XY geometry, limited testing of two BPA schemes has been performed with encouraging results. Here, the authors provide Fourier analyses of one of these schemes applied to several popular spatial discretizations.

52737 **Multigrid methods for S/sub N/ problems.** Nowak, P.F.; Larsen, E.W.; Martin, W.R. (Univ. of Michigan, Ann Arbor (USA)). *Transactions of the American Nuclear Society;* **55**: 355-356(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

It has long been known that the standard source iteration (SI) method for obtaining iterative solutions of S/sub N/ problems is very slowly converging in optically thick regions with low absorption. The rebalance and diffusion synthetic acceleration (DSA) methods are generalizations of SI that have been developed to accelerate convergence, but neither of these methods has been completely successful. In particular, the rebalance method tends to become unstable in problems where it is needed most (problems with high scattering ratios c = 1), while the DSA method, to be implemented in a stable fashion, requires the solution of a particular system of acceleration equations, and this has been done efficiently in two-dimensional geometries only for the diamond difference S/sub N/ equations. This paper discusses another extension of the SI method, namely, SI combined with the spatial multigrid algorithm (SIMG). This appears to be a viable way to accelerate many S/sub N/ problems in multidimensional geometries, provided the finest mesh consists of cells that are not optically thick.

52738 **Smart first collision sources for electron transport calculations.** Filippone, W.L.; Woolf, S.; Garth, J.C. (Univ. of Arizona, Tucson (USA)). *Transactions of the American Nuclear Society;* **55**: 356-358(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The use of analytic first collision sources can greatly improve the accuracy of neutral particle S/sub N/ calculations. For electrons, because of the strong anisotropy of the electron scattering kernel, many collisions are required before the flux from a beam source is smooth enough to lend itself to practical numerical treatment. Thus the use of a conventional analytic first collision source is of little value. With smart scattering theory, the true electron scattering law is replaced by an equivalent one that involves many times fewer collisions but larger angular deflections per collision. With such a scattering law, the electron transport emulates that of neutral particles. Hence, application of an analytic first collision source should be effective. However, smart scattering cross sections are defined in terms of a scattering matrix and thus only apply for scatter from one quadrature direction to another. Here, the authors extend the theory to include scatter from (but not to) an arbitrary beam direction. This entails the generation of one additional column S/sup b/ of the smart scattering matrix. The m'th element S/sup b/ of the vector S/sup b/ is a smart cross section for transfer from the beam to direction Omega/sup m/.

52739 **Quasi-deterministic approximation of the Monte Carlo importance function.** Booth, T.E. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society;* **55**: 358-359(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

There are many Monte Carlo biasing techniques that require approximate importance information. Often the geometry is complicated, and Monte Carlo estimates of the importance function are used in lieu of a deterministic calculation that has problems with the geometry. There are a number of Monte Carlo techniques that can be used to provide importance/biasing information. The technique described here is unique because it allows the user to divide the phase space into user-selected regions and use Monte Carlo to estimate the average region i to region j transport parameters and scores for the transport. This information is then used to form a discrete state transport problem that can be solved deterministically.

52740 **Two-dimensional electron transport calculations using the streaming ray method.** Smith, M.S.; Filippone, W.L. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society;* **55**: 361-362(1987). (CONF-8711195—).

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

A new deterministic method for two-dimensional electron transport studies is described. Results are compared with Monte Carlo calculations and show excellent agreement for energy deposition in a homogeneous medium. The method of streaming rays (SRs) has been shown previously to be an effective algorithm for one-dimensional electron transport studies. The Spencer-Lewis equation is solved for the electron distribution in direction μ, position x, and path length s, and the continuous slowing down approximation is used to relate energy less to distance traveled, so that path-length-dependent cross sections can be defined. The SR algorithm for electron transport calculations is advantageous because it facilitates modeling of the continuous energy loss.

6550 Medical Physics

REFER ALSO TO CITATION(S) 50600, 50873, 51282, 51406, 51976, 52308, 52354, 52363, 52425

52741 **(CEA-R—5425) Dosimetric properties of textile fibers: application of electron paramagnetic resonance dosimetry to an accidental gamma irradiation.** Kamenopoulou, V. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). 1987. 202p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754946/JAW.

The dosimetric properties of some twenty textile fibers have been studied in order to develop a method for determining the dose received in the case of an accidental gamma irradiation. Three textile fibers having properties most closely satisfying our needs were selected for detailed investigations: cotton, polypropylene and quartz. Electron Paramagnetic Resonance (EPR) readout techniques were used. In order to eliminate spectral anisotropy problems due to textile fiber inhomogeneities, a system has been developed to rotate samples in the resonant cavity during measurements. The structure, physical and chemical properties of cotton and polypropylene were investigated. A bibliographic study of the combined effects of light, heat and ionizing radiation on textile fibers was carried out. A linear relation exists between the EPR signal and the gamma ray dose received over a certain dose range. A method has been developed for preparing samples so as to reduce background noise not due to irradiation; in this way the detection threshold is lowered and a greater time stability obtained. Unknown doses corresponding to known spectra are determined by linear interpolation using a series of spectra obtained from the same fabric irradiated with known doses.

52742 (CONF-760202—, pp 418-421) **Bureau of radiological health compliance testing procedures for cabinet S-ray systems.** Miller, E.A.; Sprau, D. (Food and Drug Administration, Rockville, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A manual has been developed by the Bureau of Radiological Health of the Food and Drug Administration to establish procedures for the routine field testing of cabinet x-ray systems to determine compliance with the Federal Performance Standard for Cabinet X-Ray Systems, 21 CFR 1020.40. The manual provides specific instructions for testing each model of cabinet x-ray system. Results from the inspection are recorded on a data from which is designed to permit automatic data processing.

52743 (CONF-760202—, pp 422-424) **Use of the MDH monitor for x-ray machine performance and compliance surveys.** Rubin, L.M. (Radiation Physics, Incorporated, Silver Spring, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A critical evaluation of the MDH Industries x-ray monitor has been performed comparing its characteristics to those of other widely used monitors. The MDH monitor has been used satisfactorily in performing numerous surveys of various diagnostic and therapeutic x-ray units. In an energy range from 20 keV to 1.33 MeV, the response of this instrument compares favorably to other NMB calibrated instruments for dose rates over a range from 60 mR/min, to 620 R/min. and integrated doses from 30 mR to 80 R. Its versatility and ease of operation also proved beneficial.

52744 (CONF-760202—, pp 436-439) **DENT: a quality assurance program in dental radiography.** Gross, R.E.; Crabtree, L.; Bunge, R.E. (Food and Drug Administration, Rockville, MD (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Data from the Nationwide Evaluation of X-Ray Trends program showed that some dental facilities were conducting intraoral radiographic examinations with higher than acceptable exposure levels. A Bureau-sponsored program known as DENT (Dental Exposure Normalization Technique) is designed to reduce unnecessary radiation exposure and improve diagnostic quality of dental radiographs. In the DENT program a health agency sends TLD cards to all dental x-ray facilities. They are exposed by the dentists and returned for analysis. Facilities which show excessive exposure are then visited to demonstrate the changes in exposure and processing necessary to produce diagnostic quality radiographs with minimum patient exposure. Radiation control agencies which have completed the DENT program report an average exposure reduction of 600 mR per film for those machines that exceeded an empirically-determined acceptable exposure range. Twenty-seven radiation control agencies are now participating in the DENT program.

52745 (CONF-760202—, pp 445-449) **Clinton P. Anderson Meson Physics Facility and its operational safety program.** Putnam, T.M. (Univ. of California, Los Alamos, NM (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The Clinton P. Anderson Meson Physics Facility (LAMPF) at the Los Alamos Scientific Laboratory consists of a medium-energy, high-intensity linear proton accelerator; experimental areas designed to support a multidisciplined program of research and practical applications; and support facilities for accelerator operations and the experimental program. The high-intensity primary and secondary beams at LAMPF and the varied research program create many interesting and challenging problems for the Health Physics staff. This paper will present a brief overview of LAMPF and will describe the Operational Safety Program, with emphasis on the radiological safety and health physics aspects.

52746 (CONF-760202—, pp 548-552) **Health physics experience with nondestructive X-radiation facilities in the US Air Force.** Stencel, J.R.; Piltingsrud, H.V. (Radiological Health Laboratory (AFLC), Wright-Patterson Air Force Base, OH (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Radiation safety experience in the construction and use of enclosed nondestructive inspection (NDI) facilities in the US Air Force, has reaffirmed the constant need for the health physicist to continually monitor and assit in upgrading these facilities. Health physics contributions include evaluation of initial shielding requirements, proper selection of construction material, insuring that adequate safety devices are installed and adequate personnel dosimetry devices are available, surveying the facility, and assisting in the safety education program. There is a need to better define NDI warning/safety devices, using the National Bureau of Standards, (NBS) Handbook 107 as the most applicable guide.

52747 (CONF-760202—, pp 632-634) **As low as practicable (ALAP) - what's happening.** Campbell, C.M.; Baker, K.R.; Ross, D.M. (Energy Research and Development Administration, Washington, DC (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The concept of maintaining radiation exposures, As Low As Practicable, ALAP, as applied within ERDA and ERDA contractor facilities is discussed. ERDA policy and guidance is reviewed, followed by a sampling of approaches being used by ERDA contractors in their implementation of ALAP. Some examples of the application of ALAP techniques to specific tasks are included.

52748 (CONF-760202—, pp 762-768) **Calibration of superficial X-ray machines - assessment of possible error using the Victoreen medium energy chamber.** Sayeg, J.A.; Rice, R.E.; Smith, J.R. (Univ. of Kentucky Medical Center, Lexington (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

The purpose of this investigation was to document typical differences between the medium and low-energy Victoreen chambers when used in the calibration of superficial x-ray machines. The model 131 medium-energy chamber has been compared with the model 651 low-energy chamber. This study was deemed important from the viewpoint that the 100 R medium-energy condenser chamber has been widely used in the calibration of low-energy x-ray machines and that under certain conditions of low filtration, significant errors could be encountered. The authors data indicate that errors as large as twenty-five percent could be encountered at very low half-value layers such as observed in Beryllium window x-ray tubes. For a half-value layer of 1 mm of aluminum, a ten percent error is indicated. The data also indicate that the medium-energy chamber does not approach its proper response (at the 42 keV calibration point) until a half-value layer of 2 mm of aluminum is obtained.

52749 (IAEA-TECDOC—460) **Concept and approaches used in assessing individual and collective doses from releases of radioactive effluents.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1988. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704115/JAW.

To guide on the applications of the principles for limiting radioactive releases contained in Safety Series 77, the Agency is in the process of preparing a number of safety guides. The first one is this present document which deals with the principal aspects of the methods for the assessment of the individual and collective dose. It aims at giving a general guidance to those responsible for establishing programmes for the determination of individual doses as well as collective doses in connection with licensing a site for a nuclear installation. The document is concerned with the principles applied for calculating individual and collective doses from routine releases of radionuclides to the atmosphere and hydrosphere but not releases directly to the geosphere, as in waste management. These areas will be covered by other Agency publications. 75 refs, figs and tabs.

52750 (INIS-BR—1238) **Cytogenetic biological dosimetry. Dose estimative in accidental exposure.** Santos, O.R. dos; Campos, I.M.A. de. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). [1988]. 41p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704125/JAW.

The methodology of cytogenetic biological dosimetry is studied. The application in estimation of dose in five cases of accidental exposure is reported. An hematological study and culture of lymphocytes is presented. (M.A.C.).

52751 (INIS-mf—11261, pp 28-33) **Population dose calculation technique.** Belyaev, V.A. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

An original method is suggested for calculating the population doses from gas and aerosol radioactive releases. The method is based on the assumption of uniform population and arable land distribution. The validity of this assumption has been proved for a rather large condition range. Though, some modified formulae are given to take into account the non-uniformity of population distribution, connected with large cities, on the one hand, and with woods, shores, regional borders, on the other hand. Employment of the suggested method results in an apriciable calculation accuracy rise for the long-living slowly precipitating radionuclides as compared with the existing methods. 7 refs.

52752 (INIS-mf—11261, pp 103-111) **Population doses in Kozloduj NPP region due to stack radioactivity releases.** Khristova, M.; Vasilev, G. 1984. (In Russian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780181/JAW. (CONF-8205317—).

From Radiation safety of nuclear power plants operation conference; Vil'nyus, USSR (1 May 1982).

Individual and collective population doses in 50km zone around Kozloduj NPP have been calculated on the basis of mathematical models taking into account the artificial radionuclides migration in the biogeocenoses system. The actual dynamics of the stack radionuclide releases was considered as well as meteorological, landscape and demographic conditions. The average annual population equivalent dose in Kozloduj NPP region did not exceed 0.7 man.Sv. while the average value over 1974-1980 period was 0.3 man.Sv. That means for the population in Kozloduj NPP region the dose level 0.2-0.5% over the natural radiation background. 9 refs.; 4 tabs.; 1 fig.

52753 **(NEI-NO—48) Doses to the Norwegian population from naturally occuring radiation and from the Chernobyl fallout.** Strand, T. (Oslo Univ. (Norway). Fysisk Inst.). 1987. 225p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754481/JAW.

The doses to the Norwegian population from naturally occuring radiation are extensively reviewed. The annual population weighted average dose equivalent to the Norwegian population from /sup 222/Rn and its daughters is estimated to be between 3.5 and 4.5 mSv. The average concentration of /sup 220/Rn daughters in Norwegian dwellings is most probably between 1.0 and 1.5 Bq m/sup -3/. The corresponding effective dose equivalent for /sup 220/Rn and its daughters is estimated to be between 0.4 and 0.6 mSv. The total annual collective dose equivalent from naturally occuring radiation in Norway is found to be between 21000 and 27000 man Sv. The doses to the Norwegian population from the Chernobyl fallout are briefly discussed. Based on the results of a "food basket" project and supplementary data from about 30000 measurements on food samples the first year after the reactor accident, the total annual effective dose equivalent from foodstuffs to an average Norwegian consumer during this first year is estimated to be 0.15 +-0.002 m Sv at the 95% confidence level. The per caput effective dose equivalent from external fallout gamma radiation in the first year after the Chernobyl accident, is approximately 82 μSv in Norway. Reprints of eight previously printed papers; 242 refs.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 50982, 51632, 51634, 51634, 51678, 51712, 51719

52754 **(ANL—88-8) A systematic analysis of the spectra of the lanthanides doped into single crystal LaF_3.** Carnall, W.T.; Goodman, G.L.; Rajnak, K.; Rana, R.S. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 143p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88016317/JAW.

The optical spectra of the lanthanides doped into single crystal LaF_3 have been interpreted in terms of transitions within 4f/sup N/ configurations. Energy-level calculations were based on a simultaneous diagonalization of the free-ion and crystal-field matrices using an approximate model with C/sub 2v/ site symmetry instead of the actual C_2 symmetry. Excellent correlations between experimental transition energies and the computed level structures were obtained; predicted levels are given for Pm^{3+}. Previously unpublished experimental results for Nd^{3+} and Sm^{3+}:LaF_3 are included in the tabulations. The spectroscopic data for each ion were analyzed independently, then the parameters of the effective-operator model were intercompared and systematic trends were identified. Since many of the 4f/sup N/ configurations extend well into the vacuum ultraviolet region, and thus beyond any presently available experimental observations, some of the free-ion (atomic) parameters were found to be only approximately defined by the accessible levels. However, the crystal-field parameters seem for the most part to be well established by fits to data at low energies. A new chart of the lanthanide ion 4f/sup N/ configuration energy level structures is presented. It was generated by including all of the computed crystal-field levels in the 0-50000 cm^{-1} range. In most cases, experimental analyses of individual ions extended to {approximately}40000 cm/sup {minus}1/. 94 refs., 23 figs., 10 tabs.

52755 **(BNL—41466) The roles of atomic volume and disclinations in the magnetism of the rare earth-3D hard magnets.** Bennett, L.H.; Watson, R.E.; Melamud, M. (National Bureau of Standards, Washington, DC (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880705—7). NTIS, PC A02/MF A01. Order Number TI88015197/JAW.

From International conference on magnetism; Paris, France (25 Jul 1988).

Although no clear pattern exists in the experimental data, structural factors are expected to be important to local 3d magnetism in the hard magnets. We provide a measure of two structural factors (local site volume and the presence of disclinations) so as to disentangle their role in the local magnetism. 1 ref., 1 tab.

52756 **(DOE/ER/10947—22) The behavior of matter under nonequilibrium conditions: Fundamental aspects and applications in energy-oriented problems: Progress report for period September 1984--November 1987.** Prigogine, I. (Texas Univ., Austin (USA). Dept. of Physics). 7 Oct 1987. Contract AS05-81ER10947. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016554/JAW.

This report briefly discusses progress on the following topics: state selection dynamics; polymerization under nonequilibrium conditions; inhomogeneous fluctuations in hydrodynamics and in completely mixed reactors; homoclinic bifurcations and mixed-mode oscillations; intrinsic randomness and spontaneous symmetry breaking in explosive systems; and microscopic means of irreversibility.

52757 **(DOE/ER/45275—2) Surface and interface electronic structure: Second year progress report.** Kevan, S.D. (Oregon Univ., Eugene (USA)). [1988]. Contract FG06-86ER45275. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015517/JAW.

In the past year, we have had 3-4 productive runs on the uv storage ring at the National Synchrotron Light Source. We have needed and have gotten the high quality, stable, and relatively uninterrupted beam time that we require to carry out careful, high resolution experiments which form the strength of our efforts. The experimental output has been some of the best of the PI's scientific career. In addition, we have nearly completed implementation of a vacuum system with associated surface analytical tools at the University of Oregon which we will use in preparing for future experimental runs at Brookhaven. In the years to come this will significantly enhance the sophistication of our experimental output at the NSLS. The original proposal included four major experimental areas: electronic structure of nominally clean surfaces, electronic structure of ultrathin epitaxial films, electronic structure studies of phase transitions and surface reconstruction, and small perturbations on surface electronic structure induced by adsorbates. We have currently made progress on all but the second of these, and we will dedicate roughly 1.5 weeks of beam time in August of this year to our initial studies in this area. 2 figs.

52758 **(DTH-LTF3—59) X-ray energy dispersive diffraction.** Buras, B.; Gerward, L. (Risoe National Laboratory; Technical University of Denmark). (Technical Univ. of Denmark, Lyngby (Denmark). Lab. of Applied Physics 3). Mar 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754473/JAW.

Articles for inclusion in Volume C of the new edition of the International Tables for Crystallography, edited by A.J.C. Wilson and to be published by the International Union of Crystallography. 14 refs.

52759 (INIS-mf—11309, pp 140-141) **Molecular correlation in liquid solutions studied by NMR of magnetically aligned molecules.** Bastiaan, E.W.; Nibbering, E.T.J.; MacLean, C. (Vrije Univ., Amsterdam (Netherlands)). 1988. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704029/JAW. (CONF-8805190—).

From 9. European experimental NMR conference; Bad Aussee, Austria (16 May 1988).

Magnetic field alignement effects in NMR spectra provide information about molecular properties and interactions in liquid solutions. Via temperature dependent studies the influence of correlations between the molecules is clearly revealed.

52760 **(INIS-mf—11773) Moessbauer effect measurements on zinc oxide monocrystals by means of the 93.32-keV transition in /sup 67/Zn.** Schaefer, C. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). Feb 1987. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754332/JAW.

The high-resolving 93.3-keV Moessbauer transition in /sup 67/Zn was used in order to study the temperature dependence of the Lamb-Moessbauer factor (LMF), the shift of the center of mass of the Moessbauer spectrum (CS), and the electric field gradient. Thereby in the temperature range from 4.2 K to 77.3 K measurements were performed. The LMF is at low temperatures (< 50 K) within the measurement errors isotrop. At higher temperatures (> 50 K) a light anisotropy is indicated the quantity of which lies just yet beyond the measurement errors. The mean square deviation of the /sup 67/Zn nuclei increases from ≅ 0.00175 A/sup 2/ at 4.2 K to ≅ 0.00240 A/sup 2/ at 77.3 K. Both the absolute value and the temperature dependence of the LMF can be well described with an effective Debye temperature of 317 K. The CS changes between 4.2 K and 77.3 K by 9.01 μm/s. The contribution of the squared Doppler effect (SOD) to the CS was calculated from the specific heat. In the amount the SOD is about half so large as the whole observed CS. The residual CS is caused by the explicite temperature dependence of the isomer shift. A T/sup 4/ dependence of the dynamic charge transfer could in this thesis for the first time be experimentally detected. The whole CS shows at low temperatures also a T/sup 4/ dependence. For the proportionality constant the value of 5.7x10/sup -7/ μm/(sK/sup 4/) is obtained. The electric field gradient shows within the measurement accuracy (≅ 1%) no temperature dependence. (orig./HSI).

52761 (INIS-SU—37/A, pp 32-42) **Experimental spectra unfolding of fast ion backscattering.** Shipatov, Eh.T. (Rostovskij-na-Donu Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

Problems on processing of experimental spectra of fast light ion backscattering are considered to obtain information about element composition in thin films and surface layers of solids. Application of mathematical processing of the spectra is shown to allow considerably to improve analytical characteristics of the ion backscattering method and to expand the field for its application. 18 refs.; 4 figs.

52762 (INIS-SU—37/A, pp 29-31) **Optimization of depth resolution in the experiments using Rutherford backscattering and channeling method.** Tashlykov, I.S. (Belorusskij Gosudarstvennyj Univ., Minsk. Inst. Prikladnykh Fizicheskikh Problem). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

Possibilities and efficiency of optimization of experiment geometry, application of electrostatic analyzers (ESA) to increase the depth resolution when using the ion Rutherford backscattering with channelling are discussed. Δx=3...5 and 0.5...1 nm are shown to be achievable in experiments with the optimized geometry and ESA application. 8 refs.; 4 figs.

52763 (INIS-SU—37/A, pp 43-45) **On diffusion model of charged particle dechanneling in crystals.** Koshcheev, V.P.; Kryuchkov, Yu.Yu.; Boyarko, E.Yu.; Verigin, A.A.; Malyutin, V.M. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

The problem on interaction of two ways of channeled particle flux description both before and after statistic equilibrium using the Fokker-Plank equations is considered. Measurements of the energy spectra of dechanneled protons, which are well described by the given model, are carried out. 4 refs.; 2 figs.

52764 (INIS-SU—37/A, pp 65-66) **On anomalous behaviour of energy dependence of yield of resonance nuclear reaction excited by channeled molecular ions H/sub 2//sup +/.** Deev, A.S.; Olejnik, V.A.; Svetashov, P.A.; Skakun, N.A.; Storizhko, V.E.; Chirt, V.K. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

The excitation function for the reaction /sup 15/N(p,α, γ)/sup 12/C in the 898 keV resonance range for the <100> axis is measured. Distinct decrease in γ-quanta emission for the channeled molecular H/sub 2//sup +/ beam is observed in comparison with monatomic H/sub i//sup +/. A complex structure of the excitation function is marked. Effect of the energy redistribution dynamics of the Colomb interaction between protons in cluster H/sub 2//sup ++/, the values of bremstrahlung losses of channeled ions and the width of reaction resonance on the excitation function behaviour is theoretically investigated. 1 ref.; 3 figs.

52765 (INIS-SU—37/A, pp 82-86) **Radiation-induced effects in silicon diode structures under different energy electron irradiation.** Babadzhanov, R.D.; Badalova, Sh.D.; Dobrovinskij, Yu.M. (Tashkentskij Gosudarstvennyj Univ. (USSR)). 1987. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780177/JAW.

Voprosy atomnoj nauki i tekhniki.; no. 1(37).

In General and nuclear physics. Scientific-technical collection.

Effect of electron irradiation on the spectrum of deep levels and electrophysical characteristics of silicon diode structures in the energy range from 0 to 30 MeV and dose rates from 10/sup 13/ to 10/sup 16/ el/cm are systematically studied. 21 refs.; 4 figs; 1 tab.

52766 (INIS-SU—46, pp 3-5) **Nature of luminescence quenching centers in lead telluride.** Zelikman, I.N.; Kiseleva, K.V.; Revokatova, I.P. 1987. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780179/JAW.

Kratkie Soobshcheniya po Fizike.; (no.9).

In Experimental and theoretical physics. Collection.

It is established that structural defects of PbTe epitaxial layers having an X-ray diffraction contrast in the form of 'dark zones' are microinclusions of excessive component which are centers of radiationless recombination. 7 refs.; 1 fig.; 1 tab.

52767 **(KFK—4053) KfK, Institute for Nuclear Solid-State Physics. Report of results on research and development work 1985.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Festkoerperphysik). Feb 1986. 18p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754669/JAW.

The Institute for Nuclear Solid-State Physics pursues at time mainly basis-oriented work in the fields of superconductivity and the boundary-surface and microstructure research. The experimental and theoretical works aim to a better understanding of the microscopical and macroscopical properties of certain solids. At time superconductors with high transition point, highly correlated electron systems, conducting polymers, and amorphous substances are studied especially intensively. Technologically relevant materials have in the comparative case preference. Beside the experimental methods of nuclear solid-state physics (neutron scattering, Moessbauer spectroscopy, ion-implantation technology, irradiation and analysis with fast ions) the institute disposes of further highly specificated techniques, like electron-energy-loss-spectroscopy, special material preparation, X-ray diffractometry, and two UHV facilities for the study of the first surface respectively near-surface regions with thermal helium atoms as well as with fast ions. (orig./HSI).

52768 (KURRI-TR—296, pp 66-70) **Study on magnetic oxides by means of /sup 111/Cd(<-/sup 111/In)TDPAC.** Asai, K.; Okada, T.; Ambe, F.; Ambe, S.; Yamadaya, T.; Sekizawa, H. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Nov 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900377/JAW. (CONF-8707148—).

From 1. KUR symposium on hyperfine interactions; Kyoto, Japan (20 Jul 1987).

52769 (KURRI-TR—296, pp 78-81) **Multi-parameter TDPAC data acquisiton system.** Uehara, S.; Kawase, Y. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Nov 1987. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900377/JAW. (CONF-8707148—).

From 1. KUR symposium on hyperfine interactions; Kyoto, Japan (20 Jul 1987).

52770 **(LA-UR—88-2599) Proton conductivity in quasi-one dimensional hydrogen-bonded systems: A nonlinear approach.** Tsironis, G.; Phevmatikos, S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 53p. (CONF-8805187—1). NTIS, PC A04/MF A01. Order Number DE88016342/JAW.

From Disorder and nonlinearity conference; Los Alamos, NM, USA (4 May 1988).

Defect formation and transport in a hydrogen-bonded system is studied via a two-sublattice soliton-bearing one-dimensional model. Ionic and orientational defects are associated with distinct nonlinear topological excitations in the present model. The dynamics of these excitations is studied both analytically and with the use of numerical simulations. It is shown that the two types of defects are soliton solutions of a double Sine–Gordon equation which describes the motion of the protons in the long-wavelength limit. With each defect there is an associated deformation in the ionic lattice that, for small speeds, follows the defect dynamically albeit resisting its motion. Free propagation as well as collision properties of the proton solitons are presented. 33 refs., 10 figs.

52771 **(LA-UR—88-2613) The extended Peierls-Hubbard model: Off-diagonal model.** Campbell, D.K.; Gammel, J.T.; Loh, E.Y. Jr. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880669—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016338/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

We investigated the effects of including "off-diagonal" terms{endash}nearest-neighbor bond-bond repulsion (W) and bond-site repulsion (X){endash}in the extended Peierls-Hubbard model. As a specific illustration we study the ground state dimerization in one-dimensional, half-filled-band models that have been widely applied to conjugated polymers such as {ital trans}-polyacetylene and related charge density wave systems. 17 refs., 5 figs.

52772 **(LBL—25691) Pressure dependence of Schottky barrier height at Pt/GaAs interface.** Shan, W.; Li, M.F.; Yu, P.Y.; Walukiewicz, W.; Hansen, W.L. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 7p. (CONF-8808106—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016644/JAW.

From 15. international conference on defects in semiconductors; Budapest, Hungary (22 Aug 1988).

The pressure dependence of Schottky barrier height at the Pt/GaAs interface has been studied using a diamond anvil cell. The pressure coefficient of the Schottky barrier height suggests that whatever states responsible for the Fermi level pinning follow the valence band edge under pressure. Within models that simple intrinsic defects are responsible for the formation of Schottky barriers in GaAs, our results suggest that these intrinsic defects may involve vacancies. 18 refs., 2 figs.

52773 **(LBL—25692) Reduction of capture barrier height of pressure-induced deep donors (DX center) in GaAs:Si.** Li, M.F.; Yu, P.Y.; Shan, W.; Hansen, W.L.; Weber, E.R. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 8p. (CONF-8808106—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016639/JAW.

From 15. international conference on defects in semiconductors; Budapest, Hungary (22 Aug 1988).

When boron was introduced into GaAs:Si, the DX-like deep donors which appeared in GaAs under pressure were found to disappear while new centers with reduced capture barrier heights appeared. It is proposed that B atoms paired up with Si donor atoms. The reduction in the capture barrier height is interpreted in terms of a recent model proposed by Chadi and Chang. 12 refs., 3 figs., 1 tab.

52774 **(ORNL/TM—10876) SIMDLA: A FORTRAN program simulating diffusion-limited aggregation.** Renker, L.A.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016517/JAW.

This report documents a FORTRAN program designed to simulate the diffusion-limited aggregation of particles. Particles are released one at a time from a growing internal boundary on a grid of possible sites and allowed to walk randomly until they either stick to the growing cluster or walk off the grid. The user may specify the grid dimension, the number of particles to be added to the cluster, the location and size of the seed cluster, and the possible directions (up to eight) in which particles are allowed to move. The output is a list of the occupied cells after all particles have been added to the cluster. A graphics post processor creates pictures from this list. 14 refs., 5 figs.

52775 **(SAND—88-2020) Initial assessment of the use of an ion beam to simulate soft x-ray effects on a multi-layer surface.** Harper-Slaboszewicz, V.J. (Sandia National Labs., Livermore, CA (USA)). Aug 1988. Contract AC04-76DP00789. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016865/JAW.

Ion beams can be used to simulate the effects of soft x-ray energy deposition in single-component materials like aluminum. The extension of this application to multi-layered materials such as are found on optical surfaces is considered here for a reference surface consisting of six layers of alternating ZnS and ThF_4, with each layer .3 μm thick. Energy deposition by 1--10 keV blackbody spectra and by 100keV--10MeV protons are calculated. In this reference surface, ion beams do not reproduce the differential energy deposition profiles produced by soft x-rays, and in fact produce deposition gradients of the wrong polarity. To the extent that the x-ray effects

depend on the differential energy deposition, ion beams do not provide a good simulation of soft x-ray effects on the reference multilayered surface. 5 refs., 7 figs., 1 tab.

52776 **Slow electrons in condensed matter: The large polaron.** Stephens, J.A.; Fano, U. (The James Franck Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3372-3376(1 Oct 1988).

We discuss the interactions and energy dissipation of subexcitation electrons in homogeneous and isotropic condensed materials in the framework of a perturbative, generalized polaron theory. The polaron structure includes only Fourier components of the Coulomb interaction with momentum transfers $(h/2\pi)q$ less than the polaron momentum p, thus limiting the treatment to long-range coupling. The coupling between the electron and rovibrational modes of the material is represented by off-diagonal form factors. The energy contributed to the polaron by virtual excitations is represented by the real part of a perturbation term, whose imaginary part represents energy dissipated (irreversibly) into other excitations. Quantitative knowledge of the relevant parameters remains undeveloped.

52777 **Thermodynamical implications of a violation of the Pauli principle.** Rahal, V.; Campa, A. (Department of Physics, The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 7, 3728-3731(1 Oct 1988).

We suggest a mechanism allowing the introduction of a small violation of the Pauli exclusion principle. Within this framework, we compute the grand partition function for a free-electron gas in a metal. We discuss the physical implications of our results and infer an upper bound on the violation parameter.

52778 **Dynamics of kink-kink collisions in the double-sine-Gordon system.** Ravelo, R.; El-Batanouny, M.; Willis, C.R.; Sodano, P. (Department of Physics, Boston University, Boston, Massachusetts 02215). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 7, 4817-4826(1 Sep 1988).

We study the double-sine-Gordon kink-kink collisions in a formalism which employs collective variables to describe the internal oscillations of the kinks and their translational motion in their center-of-mass frame. The equations of motion are solved in the absence of the radiation field and dynamical dressing and the results are compared with numerical molecular-dynamics simulations. We investigate the energy exchange between the translational and internal modes, and a mechanism is proposed to explain the values of the translational velocity at which maximum energy is exchanged between the two modes.

52779 **Current oscillations in near-commensurate systems.** Bishop, A.R.; Horovitz, B.; Lomdahl, P.S. (Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 7, 4853-4862(1 Sep 1988).

The phenomena of current oscillations (CO) in response to a dc field is studied by the one-dimensional damped and field-driven sine-Gordon equation. For low damping we find that kink-antikink pairs survive collisions and CO through periodic boundaries is possible. For large damping CO is possible if the field is inhomogeneous, e.g., at contacts, creating kink-antikink pairs periodically. The results can account for data on charged-density waves and vortex lattice motion in superconducting films and annular Josephson junctions.

52780 **Quasiperiodic anisotropic XY model.** Satija, I.I.; Doria, M.M. (Department of Physics, George Mason University, Fairfax, Virginia 22030). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 7, 5174-5176(1 Sep 1988).

The quasiperiodic anisotropic XY model in one-dimensional exhibits ordered and disordered phases with cantor spectra which we characterize in terms of the exponent δ and the $f(\alpha)$ curve. The transition to the long-range-order phase is signaled by a nonanalyticity in δ in addition to the singular behavior of the long-range correlation function. Based on our numerical results, we conjecture that $f(\alpha)$ is a smooth function in the disordered phase, becoming discontinuous in the ordered phase. At a special point in the ordered phase, the system exhibits a pointlike spectrum with localized states.

52781 **Interaction of positron beams with surfaces, thin films, and interfaces.** Schultz, P.J.; Lynn, K.G. (Department of Physics, The University of Western Ontario, London, Ontario, Canada N6A 3K7). *Reviews of Modern Physics;* **60**: No. 3, 701-780(Jul 1988).

Recent advances in the study of solid surfaces and thin films using variable-energy positron beams are reviewed. In the first part the authors discuss the process of positron moderation and technical aspects of positron beam production and application. The second part is (roughly) organized in sections that apply to increasing time scales appropriate to the positron-solid interaction. These are (a) first encounter and scattering effects, (b) energy loss and stopping profiles, (c) diffusion of thermalized positrons, (d) positron-surface interactions, and (e) studies of defects near surfaces and interfaces. The review is written with more emphasis on the most recent measurements and interpretations than on the chronology of various developments.

52782 **Discontinuity of the magnetization in one-dimensional 1/absolute value x-y^2 Ising and Potts models.** Aizenman, M.; Chayes, J.T.; Chayes, L.; Newman, C.M. (New York Univ., NY (USA)). *Journal of Statistical Physics;* **50**: No. 1-2, 1-40(Jan 1988).

Results from percolation theory are used to study phase transitions in one-dimensional Ising and q-state Potts models with couplings of the asymptotic form J/sub x,y/ $\approx$ const/absolute value x-y^2. For translation-invariant systems with well-defined lim/sub x $\rightarrow \infty$/x^{2}J/sub x/ = J$^+$ (possibly O or ∞) we establish: (1) there is no long-range order at inverse temperatures β with $\beta J^+ \leq 1$. (2) If $\beta J^+ > q$, then by sufficiently increasing J_1 the spontaneous magnetization M is made positive. (3) In models with $0 < J^+ < \infty$ the magnetization is discontinuous at the transition point (as originally predicted by Thouless), and obeys M(β/sub c/) $\leq$ 1/(β/sub c/J$^+$)/sup 1/2. (4) For Ising (q =2) models with $J^+ < \infty$, it is noted that the correlation function decays as $<\sigma$/sub x/σ/sub y/$>(\beta) \approx$ c(β)/absolute value x-y^2 whenever $\beta < \beta$/sub c/. Points 1-3 are deduced from previous percolation results by utilizing the Fortuin-Kasteleyn representation, which also yields other results of independent interest relating Potts models with different values of q.

52783 **Amorphization of silicon by boron ion implantation.** Shih, Y.; Washburn, J.; Gronsky, R.; Weber, E.R. (IBM T.J. Watson Research Center, Yorktown Heights, NY (US)). pp 203-210 of Materials issues in silicon integrated circuit processing. Wittmer, M.; Stimmell, J.; Strathman, M. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

Amorphization of silicon due to implantation of boron ions which is the lightest element used for I.C. fabrication processes, has been systematically studied for various temperatures, voltages and dose rates. A model for formation of amorphous silicon by light ion implantation is proposed. It is suggested that accumulation of point defects and/or clusters is required at the initial stage of amorphization process. Diinterstitial-divacancy pairs are suggested to be the embryos of amorphous zones formed during implantation at room temperature. Out-diffusion of highly mobile interstitials during amorphization is thought to explain differences in the critical energy for amorphization with low and high energy implantation at liquid nitrogen temperature.

6561 Superconductivity

REFER ALSO TO CITATION(S) 51600, 51601, 51658, 51659, 51662, 51663, 51664, 51667, 51668, 51675, 51676, 51679, 51686, 51792, 52779, 52809

52784 **(BNL—41544) Theory of oxygen diffusion in 1,2,3 superconducting compounds.** Bakker, H.; Welch, D.O.; Westerveld, J.P.A.; Lo Cascio, D.M.R. (Brookhaven National Lab., Upton, NY (USA); Amsterdam Univ. (Netherlands). Natuurkundig Lab.). 1988. Contract AC02-76CH00016. 10p. (CONF-880653—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015819/JAW.

From International conference on cryogenic materials applications and properties; Shenyang, China (7 Jun 1988).

Results of a theoretical model of the oxygen diffusion in 1,2,3 high-T/sub c/ superconductors (Y Ba_2Cu_3 O/sub 7-x/) are given. 9 refs., 9 figs.

52785 **(CEA-N—2553-1) Longitudinal propagation of the normal zone through indirectly cooled superconducting solenoids.** Devred, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires; Institut National Polytechnique, 54 - Nancy (France)). Mar 1988. 405p. (In French). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88754788/JAW.

This work deals with the longitudinal propagation of the normal zone in large thin super-conducting solenoids like CELLO. From the theoretical point of view, we begin to explain, under the name of classical model, a synthesis of the models known in the literature. Then we study successively the influence of four phenomenons, which until then were neglected: 1) The current sharing zone; 2) The dependence on temperature of the specific heat and of the thermal conductivity; 3) The electromagnetic diffusion through a possible super-stabilizer, and 4) The thermal diffusion through a possible insulator. In each case, we re-formulate the equation of thermal and electromagnetic behaviour of the layer, we solve them analytically, and we derive a corrective factor, which is to apply to the classical formula of the propagation velocity. Finally, we investigate how to combine these corrections, and we converge on a general method of calculation of the velocity. In the experimental part, we have pointed out and measured in terms of current and field, propagation velocities along a super-stabilized conductor. Having established that the experimental conditions satisfied the hypotheses of our theoretical study, we verify that these measurements are in good agreement with the calculated velocities. Finally we concluded that our model of current redistribution through the super-stabilizer is valid.

52786 **(CEA-N—2553-2) Longitudinal propagation of the normal zone through indirectly cooled superconducting solenoids.** Devred, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires; Institut National Polytechnique, 54 - Nancy (France)). Mar 1988. 182p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88754789/JAW.

This work deals with the longitudinal propagation of the normal zone in large thin super-conducting solenoids like CELLO. From the theoretical point of view, we begin to explain, under the name of classical model, a synthesis of the models known in the literature. Then we study successively the influence of four phenomenons, which until then were neglected: 1) The current sharing zone; 2) The dependence on temperature of the specific heat and of the thermal conductivity; 3) The electromagnetic diffusion through a possible super-stabilizer, and 4) The thermal diffusion through a possible insulator. In each case, we re-formulate the equation of thermal and electromagnetic behaviour of the layer, we solve them analytically, and we derive a corrective factor, which is to apply to the classical formula of the propagation velocity. Finally, we investigate how to combine these corrections, and we converge on a general method of calculation of the velocity. In the experimental part, we have pointed out and measured in terms of current and field, propagation velocities along a super-stabilized conductor. Having established that the experimental conditions satisfied the hypotheses of our theoretical study, we verify that these measurements are in good agreement with the calculated velocities. Finally we concluded that our model of current redistribution through the super-stabilizer is valid.

52787 **(CONF-8704112—) Accelerator mass spectrometry: Proceedings of the fourth international symposium on accelerator mass spectrometry.** Gove, H.E. (ed.); Litherland, A.E. (ed.); Elmore, D. (ed.). (Rochester Univ., NY (USA)). 1987. Contract FG02-87ER13718. 462p. Elsevier Science Publishers Co. Inc., 52 Vanderbilt Ave., New York 10017. Order Number TI88013520/JAW.

From 4. international symposium on accelerator mass spectrometry; Ontario, Canada (27 Apr 1987).

This report is a volume of the journal Nuclear Instruments and Methods in Physics Research B: Beam Interactions with Materials and Atoms. This particular volume is concerned with accelerator mass spectrometry. The sections of this issue are: Advances in AMS techniques; Archaeology and ecology; Glaciology and climatology; Cosmochemistry and in situ production; Ocean and atmospheric sciences; Hydrology and geology; Astrophysics, nuclear physics and lasers.

52788 **(JAERI-M—88-040) AC loss time constant measurements on Nb/sub 3/Al and NbTi multifilamentary superconductors.** Painter, T.A. (Massachusetts Inst. of Tech., Cambridge (USA)). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754562/JAW.

The AC loss time constant is a previously univestigated property of Nb/sub 3/Al, a superconductor which, with recent technological developments, shows some advantages over the more commonly used superconductors, NbTi and Nb/sub 3/Sn. Four Nb/sub 3/Al samples with varying twist pitches and one NbTi sample are inductively measured for their AC loss time constants. The measured time constants are compared to the theoretical time constant limits imposed by the limits of the transverse resistivity found by Carr [5] and to the theoretical time constants found using the Bean Model as well as to each other. The measured time constants of the Nb/sub 3/Al samples fall approximately halfway between the theoretical time constant limits, and the measured time constants of the NbTi sample is close to the theoretical lower time constant limit. The Bean Model adequately accounts for the variance of the permeability of the Nb/sub 3/Al superconductor in a background magnetic field. Finally, the measured time constant values of the Nb/sub 3/Al samples vary approximately according to the square of their twist pitch.

52789 **(LA-UR—88-2549) Excitonic superconductivity in copper oxides.** Tesanovic, Z.; Bishop, A.R.; Martin, R.L.; Harris, C. (Los Alamos National Lab., NM (USA); Johns Hopkins Univ., Baltimore, MD (USA)). 1988. Contract W-7405-ENG-36. 12p. (CONF-880709—1). NTIS, PC A03/MF A01. Order Number DE88016228/JAW.

From Adriatico research conference: towards a theoretical understanding of high temperature superconductors; Trieste, Italy (26 Jul 1988).

We discuss the possibility of excitonic superconductivity in high T/sub c/ copper oxides. The Hamiltonians describing CuO_2 planes supports both antiferromagnetism and low-lying Cu {longleftrightarrow} O intra- and interband charge fluctuations. One crosses from one regime to another as the number of holes per unit cell increases. The high T/sub c/ superconductivity takes place at hole concentrations most favorable for intraband charge transfer excitations. The dynamic polarizability of the environment surrounding CuO_2 planes plays an important role in enhancing T/sub c/. 15 refs., 4 figs.

52790 **Mechanism for high-temperature superconductivity.** Emery, V.J.; Reiter, G. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 7, 4547-4556(1 Sep 1988).

An explanation of the mechanism for high-temperature superconductivity is given, based upon a strong-coupling analysis of the extended Hubbard model previously introduced by one of us.

The basic carriers are oxygen-hole quasiparticles in pσ orbitals, whose spin is strongly correlated with that of adjacent copper holes. These quasiparticles interact through the enhanced superexchange of the associated spins on the Cu sites, and an enhanced zero-point motion of the surrounding Cu holes. These are nonretarded attractive interactions whose strength increases as the oxygen-copper Coulomb repulsion increases and can be strong enough, for realistic parameters, to overcome the direct oxygen-oxygen Coulomb repulsion. The superconducting transition temperature that results is proportional to the Fermi energy of the oxygen holes.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 52471, 52502, 52584, 52590, 52607, 52731, 52782, 52941

52791 **(CONF-8709328—1) Molecular dynamics simulations of classical and quantum systems.** Kalia, R.K.; Vashishta, P. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011992/JAW.

From Advanced international school on statistical physics; Chandigarh, India (28 Sep 1987).

We survey the recent advances in the simulation of classical and quantum systems by the method of molecular dynamics. 15 refs.

52792 **(IFT-T—01/85) Casimir effect in spherical shells.** Ruggiero, J.R. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1985. 234p. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88704119/JAW.

The analytic regularization method is applied to study the Casimir effect for spherical cavities. Although many works have been presented in the past few years, problems related to the elimination of the regulator parameter still remain. A way to calculate the zero point energy of a perfectly conducting spherical shell which is a miscellaneous of those presented early is here proposed, How a cancelation of divergent terms occurs and how a finite parte is obtained after the elimination of the regulator parameter is shown. As a by-product the zero point energy of the interior vibration modes is obtained and this has some relevance to the quarks bag model. This relev ance is also discussed. The calculation of the energy fom the density view is also discussed. Some works in this field are criticized. The logarithmic divergent terms in the zero point energy are studied when the interior and exterior of the sphere are considered as a medium not dispersive and characterized by a dielectric constants ϵ/sub 1/ and ϵ/sub 2/ and peermeability constants μ/sub 1/ and μ/sub 2/ respectivelly. The logarithmic divergent terms are not present in the case of ϵ/sub i/μ/sub i/=K, with K some constant and i=1,2. (author).

52793 (INIS-SU—9/A, pp 92-97) **On quantum ensembles.** Smorodinskij, Ya.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

Concepts of physical reality and the wave function determinism form are considered. Discussion of the last years showed that in case of following the quantum ensemble theory, such ensembles must be attributed to unusual properties, that are not consistent with the standard probability theory. Thse properties are not seen in a single particle and may be detected in correlation effects. Similar to non-Euclidean geometry, necessary for description of the rate space in special relativity theory, quantum mechanics gives rise to non-Kolmogorov probability theory. The author considers this to be the essence of analysis of quantum ensemble properties.

52794 (INIS-SU—9/A, pp 122-138) **Principles of general relativity theory in terms of the present day physics.** Pervushin, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

A hystory of gradual unification of general relativity theory and quantum field theory on the basis of unified geometrical principles is detected. The gauge invariance principles became universal for construction of all physical theories. Quantum mechanics, electrodynamics and Einstein gravitation theory were used to form geometrical principles. Identity of inertial and gravitational masses is an experimental basis of the general relativity theory (GRT). It is shown that correct understanding of GRT bases is a developing process related to the development of the present physics and stimulating this development.

52795 (INIS-SU—9/A, pp 184-203) **Gauge theory of gravity.** Ivanenko, D.D.; Sardanashvili, G.A. (Moskovskij Gosudarstvennyj Univ. (USSR)). 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number TI88780182/JAW. (CONF-8301122—).

From Seminar devoted to the 75th anniversary of D. I. Biokhintsev; Dubna, USSR (23 Jan 1983).

Ideas on structure of gravitation theory and unification of gravitation and space-time with ordinary matter is developed. It is shown that realization of relativity and equivalence principles leads directly to the gauge theory (GT) of Lorentz group with spontaneously broken symmetry. This theory is a minimal gauge model and coinsides with Einstein-Kartan theory of gravitation with torsion. It is shown that in standard GT with Poincare group it is impossible to attach the importance of translation group gauge field to a tetrad gravitational field.

52796 **(ITEF—20(1987)) Relaxation time of temperatures for completely ionized matter and radiation.** Imshennik, V.S.; Molodtsov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703289/JAW.

The work is devoted to calculating the rate of energy exchange (relaxation time) between completely ionized matter and radiation, i.e. between electrons and photons. Calculations are conducted in a non-relativistic approximation for electrons, but arbitrary degree of their degeneration is taken into account. Initial stopping process cross sections are taken in quasiclassical and Born approximations, and then corresponding relation coefficients are derived for a wide range of the matter parameters: temperature T and degeneration parameter phi=exp (μ/kT) (μ-electron chemical potential). Difference of quasiclassical and Born approximations was insufficient with the exception of maximally strong degeneration phi>>1. For practical applications the obtained relaxation coefficients are extrapolated to the area of final differences T-T/sub 2/, where T/sub 2/ is the radiation temperature. Compton scattering process contribution is evaluated. 4 refs.; 4 tabs.

52797 **(ITEF—84(1987)) Program for computations in many-body system of unequal masses by means of the modified Monte-Carlo method for Green functions.** Polikarpov, M.I.; Shevchenko, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703295/JAW.

Algorithm for calculating a many-body system with unequal mass using a modified Monte-Carlo method for the Green function is considered. The program is intended for solving the Schroedinger equation for an N-body system for an arbitrary interaction potential. Expressions for control function, experimental potential and density matrix which are used in the program are presented. Complete text of calculation programs is presented and methods of operation with it are described. Calculation time according to the program is directly proportional to the number of N/sup 4/ bodies of space dimensions d. 6 refs.

52798 **(JINR—R-11-87-303) Application of the Reduce system for problems of hydrogen atom in an electric field.** Vinitskij, S.I.; Rostovtsev, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703417/JAW.

Submitted to the Orgcomittee European conference on computer algebra Evrokal-87, Lejptsig, GDR, Jun 1987.

The work demonstrates the possibilities of the REDUCE for solving perturbation theory (PT) problems of quantum mechanics in the language of the dynamic-symmetry group SO(4.2). For example, the subroutine STARK for analytical calculation in k-th order PT of energy and wave functions of a hydrogen atom in a uniform electric field is presented. 7 refs.

52799 **(LA-UR—88-2563) New gravitational forces from quantum theory.** Nieto, M.M.; Goldman, T.; Hughes, R.J. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 7p. (CONF-8808112—1). NTIS, PC A02/MF A01. Order Number DE88016231/JAW.

From 5. Marcel Grossmann conference; Perth, Australia (8 Aug 1988).

When a classical theory is quantized, new physical effects result. The prototypical example is the Lamb Shift of quantum electrodynamics. Even though this phenomenon could be parametrized by the "Uehling Potential," it was always realized that it was a quantum aspect of electromagnetism, not a "new force" of nature. So, too, with theories of quantum gravity. Generically they predict that there will be spin-1 (graviphoton) and spin-0 (graviscalar) partners of the spin-2 graviton. At some level, these partners will generate new effects. Among them are (1) non-Newtonian gravitational forces and (2) substance dependance (violation of the Principle of Equivalence). We discuss these ideas in the context of recent experiments. (Experiments usually test only one of the above effects, which could be distinct.) We contrast these ideas with the alternative point of view, that there actually may be a "fifth force" of nature. 20 refs.

52800 **(LA-UR—88-2625) A look at transport theory from the point of view of linear algebra.** Faber, V.; Manteuffel, T.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 26p. (CONF-880123—5). NTIS, PC A03/MF A01. Order Number DE88016337/JAW.

From Conference on transport theory, invariant imbedding and integral equations; Santa Fe, NM, USA (20 Jan 1988).

We show that the notion of "preconditioning" from linear algebra can provide a framework for the discussion of algorithms for the numerical solution of the transport equation. In this context we show that the conjugate gradient method yields substantial savings over the Neumann series solution of the standard integral formulation of the transport equation for optically thick regimes. Further, we show that the diffusion synthetic acceleration (DSA) algorithm is the Neumann series solution of the standard integral formulation of the transport equation preconditioning by the Green's function of a diffusion operator. The preconditioned conjugate gradient method, using DSA as a preconditioner, again yields substantial savings. 12 refs., 3 figs., 2 tabs.

52801 **(LA-UR—88-2652) Hamiltonian reduction and complex behaviour in nonlinear polarization dynamics.** David, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-8806105—1). NTIS, PC A02/MF A01. Order Number DE88016332/JAW.

From 17. international colloquium on group theoretical methods in physics; Quebec, Canada (27 Jun 1988).

The problem of two counterpropagating optical beams in a nonlinear medium is investigated as an Hamiltonian system. The phase space is an eight-dimensional manifold isomorphic to C^2 {times} C^2. Invariance of the system under the action of several copies of the O(1) group allows for its reduction to the two-sphere onto which the resulting induced Hamiltonian system is therefore completely integrable. We determine all the fixed points of the system, corresponding to physical static solutions, and examine the bifurcations that occur as parameters are varied. Orbits connecting hyperbolic fixed points are special and determine physical soliton-like and kink-like solutions. We also look at how chaos, in particular Horseshoe chaos and Arnold diffusion, arises when the system is subject to certain types of perturbations. 6 refs.

52802 **(UCRL—97390) A finite element technique for solving the two-dimensional Maxwell's equations in the time domain.** Lee, R.L.; Madsen, N.K. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 8p. (CONF-880936—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88013818/JAW.

From 1. international conference on computational methods in flow analysis; Okayama, Japan (5 Sep 1988).

In this paper, we present a two-dimensional Galerkin finite element formulation of the Maxwell's equations in the time domain. The Galerkin element integrals are computed analytically and an explicit forward-backward time integration scheme is employed for advancing the resulting set of ordinary differential equations in time. We will compare two formulations of the simple 4-node bilinear element: an equal-order interpolation element in which both the electric field and the magnetic field are approximated by bilinear basis functions; and a mixed-interpolation element in which the electric field is approximated as piecewise constant and the magnetic field as piecewise bilinear functions. The mixed formulation may be viewed as a finite element analog to certain staggered finite difference representations. Numerical examples will be presented to evaluate the accuracy of these two elements. 5 refs., 3 figs.

52803 **(UNB-FIS—02/88) PHI family and three identical quark mass spectra.** Portilho, O.; Shokranian, Z.M.O. (Brasilia Univ. (Brazil). Dept. de Fisica). Jan 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704164/JAW.

Following former non-relativistic calculations on mesons we fit a phenomenological s/sup -/s of the square-root and linear type to the PHI and PHI' masses and obtain the mass spectrum of the other states and decay widths. Comparisons with experimental data and other calculations are presented. (MWO).

52804 **Escape over a potential barrier driven by colored noise: Large but finite correlation times.** de la Rubia, F.J.; Peacock-Lopez, E.; Tsironis, G.P.; Lindenberg, K.; Ramirez-Piscina, L.; Sancho, J.M. (Department of Chemistry and Institute for Nonlinear Science, University of California, San Diego, La Jolla, California 92093). *Physical Review [Section] A: General Physics;* **38**: No. 7, 3827-3829(1 Oct 1988).

The recent theory of Tsironis and Grigolini for the mean first-passage time from one metastable state to another of a bistable potential for long correlation times of the noise is extended to large but finite correlation times.

52805 **Difficulty in detecting deviations from wave-function collapse.** Lloyd, S. (Department of Physics, The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Physical Review [Section] A: General Physics;* **38**: No. 7, 3161-3165(1 Oct 1988).

We use the example of a Stern-Gerlach apparatus to show that the quantum-mechanical measurement problem ceases to be a physical problem for a measuring device with many degrees of freedom in the sense that deviations from wave-function collapse become virtually impossible to detect.

52806 **Bandwidth considerations for binary phase-only filters.** Dickey, F.M.; Stalker, K.T.; Mason, J.J. (Sandia National Laboratories, Albuquerque, New Mexico 87175). *Applied Optics;* **27**: No. 18, 3811-3818(15 Sep 1988).

A binary phase-only filter (BPOF) bandwidth and, correspondingly, the performance with respect to stochastic noise are introduced as filter design parameters. A BPOF figure of merit is defined which references the matched filter. Analytical bounds on the BPOF signal-to-noise ratio are derived. The noise performance is illustrated with simulation results. It is demonstrated through analysis and simulation that BPOFs can be designed to perform well with respect to stochastic noise.

52807 **Equipartition of energy in a one-dimensional model of diatomic molecules.** Erpenbeck, J.J.; Cohen, E.G.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 6, 3054-3064(15 Sep 1988).

A one-dimensional model of diatomic molecules with harmonic intramolecular forces and highly anharmonic (hard-rod) intermolecular forces is studied numerically. This interaction allows a numerical integration of the equations of motion with only rounding errors, but no truncation errors. The goal was to investigate the transition from dynamics to classical statistical mechanics for this model; in particular, to check deviations from equipartition and ergodicity which have been reported in the literature for similar models. For a given number of molecules and small vibrational frequencies (much lower than those which occur in nature), no equipartition is found. However, with increasing frequency, equipartition is established, first between the two vibrational degrees of freedom and then also with the translational motion of the molecules. While for a small number of molecules and small frequencies Kol'ogorov-Arnol'd-Moser—like motion dominates, this behavior changes with increasing frequency to chaotic motion. The decay time of the vibrational-energy—time correlation function does not show any increase with frequency, in contrast to what G. Benettin, L. Galgani, and A. Giorgilli [Phys. Lett. A 120, 23 (1987)] found for a model, similar to ours but with a soft repulsive interaction. Thus, the present model behaves in accordance with classical statistical mechanics.

52808 **Path integral derivation of the Chern-Simons terms in string theories.** Das, A.; Panigrahi, P.; Maharana, J. (Univ. of Rochester, Dept. of Physics and Astronomy, Rochester, NY (US)). *Modern Physics Letters B;* **3**: No. 8, 759-766(Jul 1988).

The authors show that, in the path integral formalism, the Chern-Simons terms in string theories arise due to the anomalous behavior of the measure under gauge transformations.

52809 **Three dimensional finite element calculation of saturable magnetic fluxes and torques of an actuator.** Brauer, J.R.; Aronson, E.A.; McCaughey, K.G.; Sullivan, W.N. (CAD COMP Inc., 9076 N. Deerbrook Trail, Milwaukee, WI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **24**: No. 1, 455(Jan 1988).

A rotary magnetic actuator of highly three dimensional geometry is analyzed by the finite element method. A one quarter model composed of three dimensional finite elements is developed for analysis by the vector potential Newton Raphson approach. The nonlinear saturable magnetic fields, fluxes, inductances, energies, and torques are calculated at three armature positions. The calculated torques compare reasonably well with measurements.

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 51380

7001 Plasma Research

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52810 **(ANL/FPP/TM—224) Workshops and problems for benchmarking eddy current codes.** Turner, L.R.; Davey, K.; Ida, N.; Rodger, D.; Kameari, A.; Bossavit, A.; Emson, C.R.I. (Argonne National Lab., IL (USA)). Aug 1988. Contract W-31109-ENG-38. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016028/JAW.

A series of six workshops was held in 1986 and 1987 to compare eddy current codes, using six benchmark problems. The problems included transient and steady-state ac magnetic fields, close and far boundary conditions, magnetic and non-magnetic materials. All the problems were based either on experiments or on geometries that can be solved analytically. The workshops and solutions to the problems are described. Results show that many different methods and formulations give satisfactory solutions, and that in many cases reduced dimensionality or coarse discretization can give acceptable results while reducing the computer time required. A second two-year series of TEAM (Testing Electromagnetic Analysis Methods) workshops, using six more problems, is underway. 12 refs., 15 figs., 4 tabs.

52811 **(CEA-R—5422) Stimulated Raman scattering and ion dynamics: the role of Langmuir wave non-linearities.** Bonnaud, G.; Pesme, D. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Feb 1988. 104p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754791/JAW.

The non-linear evolution of stimulated Raman scattering by coupling of the SRS-driven Langmuir waves to ion acoustic waves is studied numerically, in a homogeneous density laser-irradiated plasma. The coupled wave amplitude behaviour is represented either by envelope equations or by complete wave-like equations. The various physical phenomena which are involved are described. This preliminary work has been presented at the 17th Anomalous Absorption Conference, held in last May, in Lake Tahoe City (USA).

52812 **(CTH-IEFT-PP—1987-15) Mode locking and the Q=2 limit.** Persson, M.; Bondeson, A. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1987. 8p. (CONF-8708272—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754470/JAW.

From Workshop on theory of fusion plasmas; Varenna, Italy (24 Aug 1987).

A numerical investigation is presented of the influence of mass flows on resistive tearing modes. It is demonstrated that plasma rotation in combination with a resistive wall may play an essential role for q-limit disruptions. For a wall with finite conductivity the q-limit is found to be q(a)=2, within the cylindrical model. This is in agreement with the operational limit of many tokamaks, for instance as reported from JET. (authors).

52813 **(DOE/ER/51112—1) Analysis of momentum and impurity confinement in TFTR: Progress report, September 15, 1987-September 14, 1988.** Stacey, W.M. (Georgia Inst. of Tech., Atlanta (USA)). Aug 1988. Contract FG05-87ER51112. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016535/JAW.

Progress of ongoing work to analyze the TFTR rotation experiments is reported. The work is carried out as Ph.D research in collaboration with the TFTR team.

52814 **(DOE/ER/52127—37) CTR plasma engineering studies: Annual progress report for 1 December 1987--30 November 1988.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1988. Contract FG02-86ER52127. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016675/JAW.

This report contains papers on the following topics: Transport Simulations of the Oscillating Field Current Drive Experiment in a Reversed Field Pinch; Alpha Particle Effects; Review: Tokamak Burn Control Executive Summary; Alpha-Particle-Induced MHD Instability for Ash Control in Burning Tokamak Plasma; and Alpha Ash Effect and Control for ITER.

52815 **(DOE/ER/53195—T1) TFTR alpha extraction and measurement: Development and testing of advanced alpha detectors: Final report.** Wehring, B.W. (North Carolina State Univ., Raleigh (USA)). 15 Feb 1988. Contract FG05-85ER53195. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015779/JAW.

Advanced alpha-particle detectors made of heavy elements were investigated as alternatives to silicon surface-barrier detectors for the "foil-neutralization technique" of alpha-particle diagnostics in fusion reactors with high neutron backgrounds. From an extensive literature review, it was decided that HgI_2 would make a more suitable detector for alpha-particle diagnostics than other heavy element detectors such as CdTe. Thus, HgI_2 detectors were designed and fabricated. Experimental tests were performed to determine detector characteristics and detector responses to alpha particles. Ra-

diation noise measurements were also performed using the North Carolina State University PULSTAR nuclear reactor for both the HgI_2 detectors and commercial Si(Au) surface barrier detectors. 15 refs., 1 fig.

52816 **(DOE/ER/53241—2) Maryland magnetic fusion research program: MS spheromak: Progress report July 1987–July 1988.** DeSilva, A.W.; Goldenbaum, G.C.; Griem, H.R. (Maryland Univ., College Park (USA). Lab. for Plasma Research). Jul 1988. Contract FG05-86ER53241. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016834/JAW.

The paper discusses the progress on the Maryland Spheromak in the following areas: experimental operation, equilibrium, stabilization, resistive decay times, and diagnostics. A short history of the devices is also given. (LSP)

52817 **(DOE/ER/53263—1) Fundamental studies of fusion plasmas: Annual performance report.** Aamodt, R.E. (Lodestar Research Corp., Boulder, CO (USA)). 23 Jun 1988. Contract FG02-88ER53263. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012972/JAW.

In this paper summary reports are given on significant new results for controlling and understanding tokamak equilibrium and stability under the application of high power ICH; the possibility of explaining and controlling high Z impurity injection in ICH auxiliary heated tokamaks; the development of a new transport and heating formalism including atomic processes and large amplitude ICH fields which is particularly applicable to tokamak edge plasmas; new results on the neoclassical transport of energetic alpha particles; and the initial evaluation of the potential for using atomic scattering events in the plasma as an explanation of enhanced plasma fluctuation radiation or as a diagnostic tool. 33 refs.

52818 **(DOE/ET/53088—334) Trapped particle instability and flute instability in tandem mirror; scale separation closure in Alfven wave turbulence.** Chen, Changye. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Aug 1988. Contract FG05-80ET53088. 165p. (IFSR—334). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88015349/JAW.

We have constructed a quadratic dispersion relation, in which various MHD and kinetic effects like ion diamagnetism, electron diamagnetism, electron-electron electron-ion collisions, ion Landau-damping, E x B drift and energetic particles are included and treated in a systematic way. The numerical study in which we use the formalism to investigate the two most likely instabilities in tandem mirror machines produced many quantitative and qualitative results about the two modes. We have proposed a physically motivated, non-perturbative closure scheme to deal with some problems in plasma or fluid turbulence. After discussing a few simple analytically tractable applications, we have applied our formalism to a model problem: the shear-Alfven turbulence. The problem is readily solved numerically to obtain the turbulent spectrum with the following features: the calculated spectrum has explicit frequency shift from the linear theory as well as explicit band-broadening in k, ω space; the frequency integrated spectrum obeys a power law in the intermediate k range, i.e., I/sub k/ {approximately} K/sup $-\alpha$/, where α approaches the value 2 in the case we studied; and the form of the power law is hardly influenced by changing low-k, high-k damping effects, or by changing the strength of the turbulence. It is very encouraging that this closure scheme is capable of producing essential features associated with a turbulence spectrum. 66 refs., 38 figs.

52819 (INIS-SU—51, pp 9-11) **Reabsorption of resonance lines in expanding spatially nonuniform plasma.** Borovskij, A.V.; Galkin, A.L.; Korobkin, V.V.; Mokrov, V.B. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

Private analytical expressions for Biberman-Holstein parameter of the resonance line are generalized for the case of transverse inhomogeneous plasma filament (layer) expansion. 9 refs.

52820 (INIS-SU—51, pp 33-34) **On the Debye potential formation in a weakly nonideal plasma.** Majorov, S.A.; Tkachev, A.N.; Yakovlenko, S.I. 1987. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780180/JAW.

Kratkie Soobshcheniya po Fizike.; (no.12).

In Quantum radiophysics. Collection.

The method of dynamics of many particles is used to study the dependence of time correlation micropotential functions on plasma parameters. It is shown that the Debye potential results from time averaging exceeding time-of-flight of the average interparticle distance. In this case the concept of the Debye potential does not loose sense even if there is in the average less than one particle in the Debye sphere. 3 refs.; 1 fig.

52821 **(INPE—4364) Conceptual design of a radio-frequency driven compact tokamak.** Galvao, R.M.O.; Ludwig, G.O.; Montes, A.; Ueda, M.; Goes, L.C.S. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil); Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. Tecnologico de Aeronautica). (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Sep 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704149/JAW.

Preliminary results of the design of a small compact tokamak are presented. The design incorporates advanced concepts as start-up and current drive by electron-cyclotron and lower-hybrid waves; plasma heating by intense ion beams; and achievement of high-β by decreasing the aspect ratio.

52822 **(IPP—III/133) New time constant in ASDEX determining the OH confinement.** Miura, Y.; Itoh, K.; Itoh, S.I.; ASDEX Team. (Japan Atomic Energy Research Inst., Tokai, Ibaraki; Kyoto Univ. (Japan). Plasma Physics Lab.; Hiroshima Univ. (Japan). Inst. of Fusion Theory). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Hiroshima Univ. (Japan). Inst. for Fusion Theory). Mar 1988. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754665/JAW.

The transient response of the stored energy to density variations is studied in ASDEX ohmic discharges. It is found that the phase delay between the stored energy to the density variations is much smaller than the energy confinement time, tau/sub E/, in the density regime where tau/sub E/ scales like the Alcator scaling (anti n/sub e/ < anti n/sub c/). The phase delay increases dramatically in the high density regime where tau/sub E/ saturates with density (anti n/sub e/ > anti n/sub c/). The phase delay associated with density increase by pellet injection is small for operation at both high and low density. The value observed with pellet injection is as short as that seen in the low density gas puffing regime.

52823 **(JAERI-M—88-037) Influence of background neutrals on charge exchange neutral spectra in ohmically heated JT-60 plasmas.** Tobita, Kenji; Kusama, Yoshinori; Nemoto, Masahiro; Takeuchi, Hiroshi; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754561/JAW.

Neutrals emitted from ohmically heated JT-60 plasmas were measured by two neutral particle analysers with different sightlines. Measured charge exchange spectra presented clear distortion arising from poloidal asymmetry of neutral sources. Ion temperature from charge exchange measurements was 10 - 30 % less than the central temperature at n-bar/sub e/ = (0.5 - 4.0) x 10/sup 19/ m/sup -3/. From the magnitude of the spectra, we determined the neutral density in the core region. At n-bar/sub e/ < approx 2.5 x 10/sup 19/ m/sup -3/, the obtained neutral density n/sub 0/ decreased as n-bar/sub e/ increased, and agreed with the neutral density expected by electron-ion recombination alone at n-bar/sub e/ = (2.5 - 4.0) x 10/sup 19/ m/sup -3/. The result indicates that the neutral density in the core region is determined by penetration of cold neutrals and their generations at n-bar/sub e/ < approx 2.5 x 10/sup 19/ m/sup -3/, and also shows that at n-bar/sub e/ >

approx 2.5 x 10/sup 19/ m/sup -3/ the neutrals are mainly generated by recombination of protons and electrons.

52824 **(JAERI-M—88-043) Experimental transport analysis code system in JT-60.** Hirayama, Toshio; Shimizu, Katsuhiro; Tani, Keiji; Shirai, Hiroshi; Kikuchi, Mitsuru. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754563/JAW.

Transport analysis codes have been developed in order to study confinement properties related to particle and energy balance in ohmically and neutral beam heated plasmas of JT-60. The analysis procedure is divided into three steps as follows: 1) LOOK ; The shape of the plasma boundary is identified with a fast boundary identification code of FBI by using magnetic data, and flux surfaces are calculated with a MHD equilibrium code of SELENE. The diagnostic data are mapped to flux surfaces for neutral beam heating calculation and/or for radial transport analysis. 2) OFMC ; On the basis of transformed data, an orbit following Monte Carlo code of OFMC calculates both profiles of power deposition and particle source of neutral beam injected into a plasma. 3) SCOOP ; In the last stage, a one dimensional transport code of SCOOP solves particle and energy balance for electron and ion, in order to evaluate transport coefficients as well as global parameters such as energy confinement time and the stored energy. The analysis results are provided to a data bank of DARTS that is used to find an overview of important consideration on confinement with a regression analysis code of RAC.

52825 **(JAERI-M—88-069) Annual report of the Naka Fusion Research Establishment for the period of April 1, 1986 to March 31, 1987.** (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 348p. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88754567/JAW.

Research and development activities of the Naka Fusion Research Establishment for the period of April 1986 to March 1987 are described. In JT-60 experiments, second phase experiments with Joule-heated plasma were performed in June and July 1986 and plasma discharge of n-bartau/sub E/ = 3.1 x 10/sup -19/ m/sup -3/ center dot sec with very low impurities was achieved in divertor configuration. Initial heating experiments in JT-60 were performed for August-November 1986 and January-March 1987. The highest central ion temperature in hydrogen discharge of 130 Million degrees, and plasma current drive by RF of 2 MA were achieved. The integrated performance tests of the NBI and RF heating systems of JT-60 were completed in July 1986, and the initial heating experiments were followed and finished in March 1987. The diagnostic system of JT-60 was successfully operated and produced large amount of valuable data. In Doublet III experiments, H-mode discharges with good confinement characteristics were achieved in divertor configurations. In JFT-2M non-circular plasma experiments remarkable results on H-mode discharge were achieved. As to studies on plasma-surface interaction, production of C/sub 2/ and C/sub 3/ compounds by chemical sputtering was confiremed and compared with the case of diamond-like surface. Data were accumurated for carbonization coating. A ceramic rotor driven by gas turbine was tested and successfully demonstrated continuous operation at 30,000 rpm in magnetic field. Development of 120 GHz Gyrotron was started focusing its objective to high power output. Experiments of IEA Large Coil Task were successfully carried out at ORNL. The demonstration poloidal coil program was progressed: Fablications of the coil and cryogenic system, and extention works of power supply from JT-60 proceeded.

52826 **(JET-R—88-03) Transverse magnetic field penetration through the JET toroidal coil and support structure.** Core, W.G.F.; Noll, P. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1988. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754527/JAW.

This report contains the results of a study of transverse magnetic field penetration through the JET magnetic field coil systems and supporting structures. The studies were carried out during the initial JET design phase (1973-78) and were part of a major radius compression plasma heating feasibility study. In view of the interest in this problem the authors have decided to re-issue the original work as a JET report. The material basically remains unchanged although better estimates of the penetration times have been obtained and typographical errors which occurred in the original have been corrected.

52827 (KFKI—1988-02/D, pp 8-22) **Edge plasma physical investigations of tokamak plasmas in CRIP.** Bakos, J.; Ignacz, P.; Koltai, L.; Paszti, F.; Petravich, G.; Szigeti, J.; Zoletnik, S. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1988. (In Hungarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703435/JAW.

In Thermonuclear plasma physics research in the Central Research Institute for Physics, Hungary. (1986-1987).

The results of the measurements performed in the field of thermonuclear high temperature plasma physics in CRIP (Hungary) are summarized. In the field of the edge plasma physics solid probes were used to test the external zone of plasma edges, and atom beams and balls were used to investigate both the external and internal zones. The plasma density distribution was measured by laser blow-off technics, using Na atoms, which are evaporated by laser pulses. The excitation of Na atom ball by tokamak plasma gives information on the status of the plasma edge. The toroidal asymmetry of particle transport in tokamak plasma was measured by erosion probes. The evaporated and transported impurities were collected on an other part of the plasma edge and were analyzed by SIMS and Rutherford backscattering. The interactions in plasma near the limiter were investigated by a special limiter with implemented probes. Recycling and charge exchange processes were measured. Disruption phenomena of tokamak plasma were analyzed and a special kind of disruptions, 'soft disruptions' and the related preliminary perturbations were discovered. (D.Gy.) 10 figs.

52828 (KFKI—1988-02/D, pp 23-37) **Interactions of tokamak plasma with solid walls.** Mezey, G.; Varga, L.; Kotai, E.; Manuaba, A.; Paszti, F.; Vizkeleti, Gy.; Hajdu, Cs.; Szilagyi, E.; Nguyen, Trong My. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1988. (In Hungarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703435/JAW.

In Thermonuclear plasma physics research in the Central Research Institute for Physics, Hungary. (1986-1987).

The interactions of tokamak fusion plasmas with solid walls of the devices were investigated on special model systems. The elastic recoil detection method was used for the determination of absolute hydrogen concentration. For the calibration of the method the scattering cross sections were measured in large ranges of scattering angle and energy. The erosion and deformation of wall surfaces were investigated by reemission of accelerated He ions. Theoretical models were developed to describe the surface undulation discovered earlier, caused by large dose He irradiation. The surface sputtering and segregation were investigated by nuclear methods and the mechanism of sputtering was simulated by computer. The surface deformation and gas reemission of Al surfaces were analyzed by Ar implementation and heat treatment. (D.Gy.) 6 figs.

52829 (KFKI—1988-02/D, pp 64-71) **Measuring and data acquisition system of the MT-1 tokamak of CRIP.** Giese, Piroska. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1988. (In Hungarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703435/JAW.

In Thermonuclear plasma physics research in the Central Research Institute for Physics, Hungary. (1986-1987).

The electronic measuring, data acquisition, storage and processing systems of the MT-1 tokamak of CRIP, Budapest are described. The data acquisition system contains timing and measurement control subsystems, A/D converters, 16 channel multiplexer, IC and floppy disk memories, controlled and connected by an intelligent CAMAC crate (ICC) system. The measuring process is controlled by a BASIC program, upgraded by machine code subroutines. The functional construction of the measurement control program and its timing properties are discussed in detail. Pre- and post-discharge measuring and dialoge units complete the direct measuring control and sampling units. The acquisited data are stored, ana-

lyzed, evaluated and displayed by a TPA 11-48 computer. The planned operation of matrix detectors with high information yield requires the application of a high capacity computer (VAX). (D.Gy.) 3 figs.

52830 **(LA-UR—88-2531) Los Alamos RFP [Reversed Field Pinch] Program plans and projected needs.** Weber, P.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880895—3). NTIS, PC A02/MF A01. Order Number DE88016224/JAW.

From MFAC summer study; Berkeley Springs, WV, USA (1 Aug 1988).

This document presents the Los Alamos proposal for some significant steps in the Reversed Field Pinch Program. The discussion is focused on the research program planned for ZTH after it begins operations in December, 1992. The discussion is presented within the context of the Technical Planning Activity (TPA) logic, and concentrates on improvements to ZTH in the mid 1990s. The present US program is coordinated through a five year plan developed by the Department of Energy and representatives of the RFP research groups. Further proposals are made in this document to augment this immediate program with several high leverage initiatives which would have significant benefits to the success of ZTH. This document first briefly describes the International RFP program, followed by a list of the ultimate goals for the ZTH experiment. The present scope of this project is then discussed. Next we discuss the improvements that would address the TPA '<E2>' issues culminating in a successful 'integrated POP' ('Proof of Principle') experiment as defined in the TPA document. 1 fig., 1 tab.

52831 **(MPQ—109) Radiation hydrodynamics in the laboratory.** (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Dec 1985. 72p. (CONF-851128—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754353/JAW.

From 17. European conference on laser interaction with matter; Rome, Italy (18 Nov 1985).

This report contains a collection of five preprints devoted to the subject of laser induced phenomena of radiation hydrodynamics. These preprints cover approximately the contents of the presentations made by the MPQ experimental laser-plasma group at the 17th European Conference on Laser Interaction with Matter (ECLIM), Rome, November 18-22, 1985.

52832 **(PPPL—2542) Improved rigorous upper bounds for transport due to passive advection described by simple models of bounded systems.** Kim, Chang-Bae; Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1988. Contract AC02-76CH03073. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015821/JAW.

The work of Krommes and Smith on rigorous upper bounds for the turbulent transport of a passively advected scalar [{ital Ann. Phys.} 177:246 (1987)] is extended in two directions: (1) For their "reference model," improved upper bounds are obtained by utilizing more sophisticated two-time constraints which include the effects of cross-correlations up to fourth order. Numerical solutions of the model stochastic differential equation are also obtained; they show that the new bounds compare quite favorably with the exact results, even at large Reynolds and Kubo numbers. (2) The theory is extended to take account of a finite spatial autocorrelation length L/sub c/. As a reasonably generic example, the problem of particle transport due to statistically specified stochastic magnetic fields in a collisionless turbulent plasma is revisited. A bound is obtained which reduces for small L/sub c/ to the quasilinear limit and for large L/sub c/ to the strong turbulence limit, and which provides a reasonable and rigorous interpolation for intermediate values of L/sub c/. 18 refs., 6 figs.

52833 **(SAND—87-3062C) Charge exchange neutral sputtering in ASDEX.** Staudenmaier, G.; Wampler, W.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880512—12). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015690/JAW.

From 8. international conference on plasma surface interactions in controlled fusion devices; Julich, F.R. Germany (2 May 1988).

Neutral fluxes to the wall of ASDEX were measured with a new energy-resolving carbon resistance probe, CRP, combined with a mechanical shutter, providing time resolution. With the new CRP having two silicon overlayers of different thickness the non-Maxwellian energy distribution of the charge exchange neutrals can be approximately determined. Using the flux and the mean energy of the particles from the resistance probe measurements, one can calculate the flux of impurities generated by sputtering. Various discharges were investigated. High impurity fluxes were observed in discharges with high power auxiliary heating. Low impurity fluxes were observed in pellet-refuelled discharges and during neutral beam heating in counter direction and H-mode discharges refuelled with pellets. Charge exchange neutral sputtering is an important impurity source representing a lower limit for impurity generation. 20 refs., 3 figs.

52834 **(SFB—162-87-N1-167) Anomalous transport and anomalous heating due to lower hybrid wave fields.** Kraemer, M.; Sollich, N.; Dietrich, J. (Bochum Univ. (Germany, F.R.). Inst. fuer Experimentalphysik 2). (Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 162 - Plasmaphysik Bochum/Juelich). Nov 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754360/JAW.

The microscopic and the macroscopic behaviour of a linear reflex discharge in the presence of low frequency turbulence is investigated under the action of moderate lower hybrid wave power. The frequency and the wavenumber spectra of both the low frequency fluctuations and the high frequency waves are measured using correlation analysis technique with two probes. The low frequency fluctuations may be attributed to drift wave turbulence. The fluctuation level raises when RF power is coupled to the plasma thus causing considerably enhanced radial transport. The coupling between the low frequency fluctuations and the high frequency waves can clearly be seen from the spectra. The high frequency wavenumber spectra measured inside the antenna are in reasonable agreement with the lower hybrid wave dispersion. However, the wavenumbers observed in the lower hybrid resonance region outside the antenna are - in contrast to the expectation - not larger than in the plasma edge region. From the electric field energy density spectra and from measurements of the density and the temperatures, a detailed energy balance can be performed. The calculated heating rates are anomalously large both for the electrons and the ions. The absorption processes, relevant for the present experiment, are discussed.

52835 **(UCRL—21075) Time dependent modeling of non-LTE plasmas: Final report.** (Lawrence Livermore National Lab., CA (USA); Science Applications International Corp., McLean, VA (USA)). Jun 1988. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016173/JAW.

During the period of performance of this contract Science Applications International Corporation (SAIC) has aided Lawrence Livermore National Laboratory (LLNL) in the development of an unclassified modeling tool for studying time evolution of high temperature ionizing and recombining plasmas. This report covers the numerical code developed, (D)ynamic (D)etailed (C)onfiguration (A)ccounting (DDCA), which was written to run on the National Magnetic Fusion Energy Computing Center (NMFECC) network as well as the classified Livermore Computer Center (OCTOPUS) network. DDCA is a One-Dimensional (1D) time dependent hydrodynamic model which makes use of the non-LTE detailed atomic physics ionization model DCA. 5 refs.

52836 **Ultrahigh magnetic fields produced in a gas-puff Z pinch.** Felber, F.S.; Wessel, F.J.; Wild, N.C.; Rahman, H.U.; Fisher, A.; Fowler, C.M.; Liberman, M.A.; Velikovich, A.L. (JAYCOR, P. O. Box 85154, San Diego, California 92138). *Journal of Applied Physics;* **64**: No. 8, 3831-3844(15 Oct 1988).

Controlled, ultrahigh axial magnetic fields have been produced and measured in a gas-puff Z pinch. A 0.5-MA, 2-cm-radius

annular gas-puff Z pinch with a 3-min repetition rate was imploded radially onto an axial seed field, causing the field to compress. Axial magnetic field compressions up to 180 and peak magnetic fields up to 1.6 MG were measured. Faraday rotation of an Argon laser (5154 A) in a quartz fiber on-axis was the principal magnetic field diagnostic. Other diagnostics included a nitrogen laser interferometer, x-ray diodes, and magnetic field probes. The magnetic field compression results are consistent with simple snowplow and self-similar analytic models, which are presented here. Even small axial fields help stabilize the pinches, some of which exhibit several stable radial bounces during a current pulse. The method of compressing axial fields in a gas-puff Z pinch is extrapolable to the order of 100 MG. Scaling laws are presented. Potential applications of ultrahigh axial fields in Z pinches are discussed for x-ray lasers, inertial confinement fusion, gamma-ray generators, and atomic physics studies.

52837 **Multidimensional similarity models for exploding foils.** Hunter J.H. Jr.; London, R.A. (Department of Astronomy, University of Florida, Gainesville, Florida 32611). *Physics of Fluids;* **31**: No. 10, 3102-3108(Oct 1988).

A general derivation of the Gaussian, isothermal similarity equations for multidimensional hydrodynamic expansions is presented. Analytical solutions for the cases of constant heating and adiabatic flow for planar, cylindrical, and spherical expansions are given. An energy integral is derived for general multidimensional adiabatic flows. For two-dimensional adiabatic expansions, a second invariant of the motion is demonstrated. It is shown that this invariant gives the asymptotic shape of a Gaussian object in terms of its initial shape. A simple model for laser heating of an exploding foil is described and the asymptotic form of the corresponding solutions are given for two and three dimensions. The similarity solutions are compared with two-dimensional numerical hydrodynamic simulations for an example of an exploding foil, designed to produce a recombination x-ray laser.

52838 **Axisymmetric magnetohydrodynamic equilibrium equations with particle, momentum, and energy sources.** Hsu, J.Y.; Chu, M.S. (General Atomics, San Diego, California 92138-5608). *Physics of Fluids;* **31**: No. 10, 3143-3145(Oct 1988).

The axisymmetric magnetohydrodynamic equilibrium equations with a flow induced by particle, momentum, and energy sources are derived.

52839 **Far-infrared scattering experiment on a bumpy torus.** Casson, W.H. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 10, 3053-3058(Oct 1988).

A far-infrared scattering experiment was installed on the ELMO bumpy torus experiment at Oak Ridge National Laboratory [Plasma Physics and Controlled Nuclear Fusion Research (IAEA, Vienna, 1975), Vol. II, p. 141]. The design allowed for coupled scanning of spatial and wave vector parameters while recording the frequency spectrum. Coherent waves and incoherent density fluctuations were observed for varying plasma conditions. Also, coherent waves were recorded in conjunction with ion cyclotron heating fast wave heating experiments, which demonstrated fast wave penetration into the plasma and ion-Bernstein wave conversion between harmonic zones.

52840 **Effect of counterstreaming ion flow on ion acoustic modes and stimulated Brillouin scattered light.** Powers, L.V.; Berger, R.L. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *Physics of Fluids;* **31**: No. 10, 3109-3115(Oct 1988).

The stimulated Brillouin scattering spectrum from a plasma is determined by the ion acoustic normal mode frequencies, which are dependent on the ion temperature and flow velocity. Thus these quantities are indirectly measured by the scattered light. The frequencies of ion acoustic normal modes and stimulated Brillouin scattered light are calculated for a model plasma formed by collisionlessly interpenetrating ion beams by assuming the ion—ion two-stream instability is marginally stable. The spectrum differs measurably from the spectrum expected from the hot, stationary plasma created by collisional stagnation. Comparison of the scattered light spectra for these two limiting cases suggests that careful observation of the scattered light near the laser frequency is a potentially useful diagnostic of the collisionality of interpenetrating ion beams.

52841 **Renormalized perturbation theory: Vlasov—Poisson system, weak turbulence limit, and gyrokinetics.** Zhang, Y.Z.; Mahajan, S.M. (Department of Physics and Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 10, 2894-2903(Oct 1988).

The self-consistency of the renormalized perturbation theory of Zhang and Mahajan [Phys. Rev. 132, 1759 (1985)] is demonstrated by applying it to the Vlasov—Poisson system and showing that the theory has the correct weak turbulence limit. Energy conservation is proved to arbitrary high order for the electrostatic drift waves. The theory is applied to derive renormalized equations for a low-beta gyrokinetic system. Comparison of this theory with other current theories is presented.

52842 **Radial fluctuation scale of ion temperature gradient driven turbulence.** Terry, P.W.; Leboeuf, J.N.; Diamond, P.H.; Thayer, D.R.; Sedlak, J.E.; Lee, G.S. (Institute for Fusion Studies, University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 10, 2920-2927(Oct 1988).

It is shown that ion temperature gradient driven turbulence supports fluctuations with broader radial scales than those inferred previously on the basis of mixing length arguments derived from the eigenfunction with lowest radial eigenmode number. These fluctuations of greater radial extent are more strongly excited and are shown to result in fluctuation levels and transport coefficients that can be considerably larger than those previously predicted. It is expected that transport of this nature would maintain ion temperature and density profiles near marginal stability in neutral beam heated and ion cyclotron resonance heated plasmas.

52843 **Magnetic helicity injection for configurations with field errors.** Finn, J.M.; Antonsen T.M. Jr. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **31**: No. 10, 3012-3017(Oct 1988).

The relative magnetic helicity and its rate of injection are computed for several examples of configurations representing magnetic fusion experiments, specifically reversed field pinches (RFP's) with field errors. Field errors, here defined to be normal components of magnetic field at the wall, are believed to have a significant effect on the loop voltage, and therefore the volt-second consumption, in RFP's. The perturbations producing these errors can arise from imbalance of the vertical field, leakage of Ohmic transformer flux, or toroidal field ripple. In the examples given, the relative helicity is the difference between two terms, which are called, respectively, the plasma linkage and the vacuum linkage. The latter quantity, which is zero for the simplified configurations studied previously, represents the linkage between vacuum fluxes occurring within the region of interest. On the other hand, the plasma linkage is the part of the relative helicity directly related to the instantaneous state of the plasma. It is found that the rate of change of the plasma linkage in the presence of poloidal field errors contains a new term proportional to the time rate of change of toroidal flux.

52844 **New quotidian equation of state (QEOS) for hot dense matter.** More, R.M.; Warren, K.H.; Young, D.A.; Zimmerman, G.B. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **31**: No. 10, 3059-3078(Oct 1988).

The quotidian equation of state (QEOS) is a general-purpose equation of state model for use in hydrodynamic simulation of high-pressure phenomena. Electronic properties are obtained from a modified Thomas—Fermi statistical model, while ion thermal motion is described by a multiphase equation of state combining Debye, Grueneisen, Lindemann, and fluid-scaling laws. The theory gives smooth and usable predictions for ionization state, pressure, energy, entropy, and Helmholtz free energy. When necessary, the results may be modified by a temperature-dependent pressure multiplier which greatly extends the class of materials that can be treated with reasonable accuracy. In this paper a comprehensive evalua-

tion of the resulting thermodynamic data is given including comparison with other theories and shock-wave data.

52845 **Finite-aspect-ratio effects on the bootstrap current in tokamaks.** Hirshman, S.P. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 10, 3150-3152(Oct 1988).

The bootstrap current in tokamaks is determined in the low collision frequency regime for arbitrary values of the aspect ratio and effect charge. The resulting expression should be useful for a quantitative analysis of currents in tokamaks.

52846 **Empirical modeling and the dependence of reversed field pinch loop voltage on edge plasma conditions.** Moses, R.W.; Schoenberg, K.F.; Baker, D.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 10, 3152-3155(Oct 1988).

Empirical modeling of the dependence of loop voltage on edge plasma conditions in the reversed field pinch is discussed. Specific concerns are raised regarding magnetohydrodynamic-based models that assume a large local dissipation of magnetic helicity at the plasma edge. A kinetic model is presented in which loop voltage can be affected by fast electrons carrying momentum directly to the walls or limiters, without a large edge helicity dissipation.

52847 **Linear theory of drift-tearing and -interchange modes.** Copenhaver, C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 10, 2937-2943(Oct 1988).

A drift dispersion relation, as applied to a resistive incompressible plasma in cylindrical geometry, is derived. This dispersion relation incorporates both drift-tearing and drift-interchange modes and is valid throughout the collisional regime by including kinetic theory factors. The dispersion relation reduces to the drift-tearing dispersion relation in the zero pressure gradient limit, and to the classical resistive dispersion relation in the zero drift limit. The electron temperature-gradient instability is still present. Now, however, the introduction of the drift-interchange instability increases the growth rate further above the drift-tearing case.

52848 **Resistive electrostatic instabilities.** Tang, W.M.; Romanelli, F.; Briguglio, S. (Associazione EURATOM-ENEA sulla Fusione, CRE Frascati, C.P. 65-00044-Frascati, Rome, Italy). *Physics of Fluids;* **31**: No. 10, 2951-2961(Oct 1988).

The appropriate toroidal equations governing the stability properties of resistive electrostatic instabilities are derived and analyzed. These equations include the influence of impurity gradients and are valid for both strongly collisional and semicollisional regimes. Analytic and numerical solutions have been obtained in the sheared slab limit with toroidal curvature effects approximated with the familiar constant gravity model. The results indicate that for relevant experimental conditions, the resistivity-gradient-driven class of electrostatic modes is difficult to excite. Hence, with the possible exception of the very edge, these instabilities do not appear to be a likely candidate to account for the large thermal transport observed in the exterior region of most tokamak plasmas.

52849 **Variational formulation for a multifluid flowing plasma with application to the internal tilt mode of a field-reversed configuration.** Ishida, A.; Momota, H.; Steinhauer, L.C. (Department of Physics, Niigata University, Niigata, Japan). *Physics of Fluids;* **31**: No. 10, 3024-3034(Oct 1988).

Standard magnetohydrodynamic (MHD) equations are extended to include arbitrary equilibrium flows and multiple fluids and an equivalent variational form is developed. This system is appropriate for the study of stability in any multifluid flowing plasma, e.g., allowing for arbitrary poloidal and toroidal equilibrium flows and accounting for the Hall terms. The variational formalism is applied to the particular case of the internal tilting instability in a field-reversed configuration (FRC). A solution by means of the Rayleigh—Ritz technique leads to the dispersion relation, from which the growth rate and marginal stability conditions are determined. A new stability regime is found for sufficiently elongated FRC's, arising as a consequence of the Hall effect. These results are compared with experiment and related theory.

52850 **Effects of optical smoothing techniques on filamentation in laser plasmas.** Schmitt, A.J. (Laser Plasma Branch, Naval Research Laboratory, Washington, D.C. 20375). *Physics of Fluids;* **31**: No. 10, 3079-3101(Oct 1988).

The effect of the induced spatial incoherence (ISI) and the random phase screen (RPS) optical smoothing techniques on the filamentation instability in laser plasmas has been investigated numerically and analytically. A two-dimensional time-dependent laser—plasma propagation code, including both ponderomotive and thermal-conduction dominated filamentation, is used to simulate the laser—plasma interaction. The results of these simulations are compared to the predictions of a simple theory that describes the filamentation of both coherent light and spatially and temporally incoherent light. It is shown that filaments driven by the thermal mechanism tend to cluster together and produce greater large scale nonuniformities in the laser illumination than the ponderomotively driven filaments. The RPS optical smoothing technique is found to reduce filamentation only if fast focusing optics (f/#approx. <5) are used. The ISI smoothing method suppresses filamentation for fast or slow focusing optics, and requires only moderate laser bandwidth ($\Delta\omega/\omega\cong 0.1\%$). In general, the ISI smoothing method provides the best suppression of filamentation. Under common laboratory conditions, filamentation is pronounced at longer laser wavelengths (1.06 μm—0.53 μm), suggesting that current experiments may be dominated by filamentation effects. Optical smoothing methods can suppress, but not eradicate, filamentation effects at these wavelengths. The optical smoothing methods are most effective in short-wavelength (0.25 μm) laser-driven plasmas. At 0.25 μm laser wavelength, ISI is found to completely eliminate filamentation effects in both time-averaged and instantaneous intensity distributions.

52851 **Ion temperature gradient mode in the weak density gradient limit.** Dominguez, R.R.; Waltz, R.E. (General Atomics, San Diego, California 92138-5608). *Physics of Fluids;* **31**: No. 10, 3147-3150(Oct 1988).

The toroidal ion temperature gradient mode (ITG mode) is analyzed in the fluid limit for flat density profiles, typical of many H-mode plasmas. It is shown that the stability boundary is not L/sub n//L/sub T//sub >//sub i//sub =/ = const ≅O(1 X2) (L/sub n/ and L/sub T//sub >//sub i/sub =/ are the density and ion temperature gradient scale lengths, respectively), as typically quoted. Rather, for large L/sub n//R the stability threshold is characterized by L/sub T//sub >//sub i//sub =//R = const≅O(0.1) with R the major radius. This result could substantially reduce the impact of ITG-mode turbulence, allowing a reconciliation of present drift wave transport models with improved H-mode energy confinement.

52852 **"Flicker" in small scale laser—plasma self-focusing.** Coggeshall, S.V.; Mead, W.C.; Jones, R.D. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 10, 2750-2752(Oct 1988).

Small amplitude, short wavelength ion acoustic waves in laser-produced plasmas cause fluctuations in the trajectories of light rays that can lead to time-dependent, self-sustaining shifting of focal spots and a somewhat random redistribution of the light near the critical surface. This flickering is seen in simulations involving small scale beam inhomogeneities over a uniform background laser profile, which model the center of a realistic laser beam. The effect can cause significant intensity multiplication in long scale length high-Z plasmas with only modest beam imperfections.

52853 **Ion-Bernstein wave propagation in tokamak edge plasma during heating in the ion cyclotron range of frequencies.** Antani, S.N.; Scharer, J.E. (Department of Electrical and Computer Engineering, University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **31**: No. 10, 3018-3023(Oct 1988).

The propagation of a directly launched ion-Bernstein wave is considered in the tokamak edge plasma region in the frequency range Ω/sub i/ $<\omega<$ 2Ω/sub i/, and in the limit of small k/sub perpendicular/ρrho/sub i/. Employing standard perturbation techniques, the wave scattering from a Gaussian spectrum of density

fluctuations and the self-modulation resulting from the ponderomotive force nonlinearity are investigated. The results for the typical parameters of the PLT tokamak [Phys. Rev. Lett. 54, 2339 (1985)] and the ALCATOR-C tokamak [Phys. Rev. Lett. 59, 1201 (1987)] indicate that the scattering effect becomes important in the edge region as the fluctuation level is increased from 1% to 30%. Also, it is found that at the power levels currently being used in the experiments, large ponderomotive modifications in the plasma density are produced in the near zone of the launcher. In the weak nonlinearity limit, the ion-Bernstein wave is found to be modulationally unstable, thus implying the possibility of localized heating.

52854 **Studies of Raman scattering from overdense targets irradiated by several kilojoules of 0.53 μm laser light.** Drake, R.P.; Turner, R.E.; Lasinski, B.F.; Williams, E.A.; Phillion, D.W.; Estabrook, K.G.; Kruer, W.L.; Campbell, E.M.; Manes, K.R.; Hildum, J.S.; and others. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **31**: No. 10, 3130-3142(Oct 1988).

In this paper a study of stimulated Raman scattering (SRS) from relatively planar plasmas irradiated with short-wavelength (0.53 μm) laser light is reported. The Novette Laser Facility [Laser Part. Beams 3, 173 (1985)] produced several kilojoules of light in 1 nsec, which allowed it to irradiate a large spot with enough intensity to produce significant Raman scattering. These experiments measured the fluence, angular distribution, spectrum, and timing of the Raman light, as a function of the average laser intensity. Reductions in the Raman fluence at low laser intensity are attributed to collisional damping. The measured SRS fluence was larger than that predicted from convective amplification of bremsstrahlung noise, as calculated using the average properties of the laser beam and the plasma. Possible contributions to the observed scattering from enhanced noise, Raman scattering within filaments, and the absolute Raman instability at density extrema are discussed.

52855 **Minimum dissipation rates in magnetohydrodynamics.** Montgomery, D.; Phillips, L. (Center for Nonlinear Studies, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 6, 2953-2964(15 Sep 1988).

Minimum dissipation rate states are explored for a current-carrying channel of magnetofluid, supported by a dc magnetic field and driven by an applied electric field. The minimization is carried out subject to the constraints of constant axial (toroidal) magnetic flux and constant time-averaged rate of supply of magnetic helicity. The solutions of the resulting Euler-Lagrange equations are sensitive to boundary conditions on the current density j. One set of boundary conditions on j leads to the same consequences as Taylor's "minimum-energy" theory. A different set leads to significantly different consequences, including a departure from the "force-free" magnetic profile and a toroidal component of current density that does not reverse at the wall when the toroidal magnetic field reverses.

52856 **Conceptual design and numerical simulation of a correlation diagnostic for measurement of magnetic fluctuations in plasmas.** Thomas C.E. Jr.; Hanson, G.R.; Gandy, R.F.; Batchelor, D.B.; Goldfinger, R.C. (Nuclear Engineering Program, Georgia Institute of Technology, Atlanta, Georgia 30332). *Review of Scientific Instruments;* **59**: No. 9, 1990-1997(Sep 1988).

It has been previously suggested that crossed-sightline correlation of electron cylotron emission might be used to measure magnetic fluctuations in high-temperature plasmas. Reported here are the results of a continuing project to determine under what conditions (if any) this measurement will be feasible. An initial conceptual design for the device hardware has been completed. Large portions of the numerical simulation are working, including ray-tracing and emission/absorption packages. An initial discussion of data analysis for the experimental data is presented, and an analysis of the uncertainty in the line center (magnetic field) measurement in terms of the experimental uncertainties is given.

52857 **Multipoint Thomson scattering measurements in a low-density plasma.** Trost, P.K.; Shohet, J.L. (Torsatron/Stellarator Laboratory, University of Wisconsin-Madison, Madison, Wisconsin 53706). *Review of Scientific Instruments;* **59**: No. 9, 1998-2001(Sep 1988).

A multipoint Thomson scattering apparatus has been constructed to measure electron temperature and density at several spatial locations in a low-density toroidal plasma discharge. A multianode microchannel-plate photomultiplier tube detector is used to provide the multipoint capability of this device. This detector, along with a simple and efficient optical collection system, allows for low-density measurements. Critical for low-density operation is a low stray light level from the laser, which has been achieved through careful design of the laser beam handling optics. The plasma parameters in which this device operates are in a regime where Langmuir probes are the usual diagnostic method. The design of this device is presented, along with electron temperature and density profiles of an electron cyclotron heated plasma in the Interchangeable Module Stellarator. Comparison is made with Langmuir probe measurements of similar discharges. Discrepancies between these methods are seen, and are attributed to plasma perturbations by the probe.

52858 **Beam density fluctuation diagnostic.** Heidbrink, W.W. (GA Technologies Inc., San Diego, California 92138). *Review of Scientific Instruments;* **59**: No. 9, 2008-2011(Sep 1988).

The conceptual design of a neutral particle analyzer that is optimized for spatially resolved fluctuation measurements is described. Estimates indicate that a pair of these analyzers could detect fluctuations in beam-ion density associated with high β instabilities in the DIII—D tokamak.

52859 **Detection of plasma equilibrium shifts with fiber-optic sensing of image currents.** Forman, P.R.; Jahoda, F.C.; Miller, G. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **59**: No. 8, 1500-1502(Aug 1988).

Plasma shifts generate opposite-polarity net shell image currents at diametrically opposed shell locations. In theory these image currents can be detected by Faraday rotation fiber-optic current sensors wound around the shell sections. In practice the validity of the measurement depends on the extent of suppression of the linear birefringence induced by the fiber coil bending and lateral pressure. Circular birefringence bias twist of 60 turns/m of 125-μm o.d. single-mode fiber is sufficient for 2-in. radii of curvature bends, in agreement with theory, while 100 turns/m of 80-μm o.d. fiber have not been successful with 1-in. radii of curvature, contrary to calculations. Different means for further suppression of linear birefringence are discussed.

52860 **Two-wavelength infrared interferometer/polarimeter system for CIT.** Ma, C.H.; Hutchinson, D.P.; Vander Sluis, K.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **59**: No. 8, 1629-1631(Aug 1988).

The results of a feasibility study of a two-wavelength infrared interferometer/polarimeter system for measurements of electron density and plasma current profiles in the Compact Ignition Tokamak (CIT) are presented. The system utilizes CO_2 lasers at a wavelength of 10.6 μm, and water-vapor lasers at 28 μm. Both magneto-optic and electro-optic polarization-modulation techniques have been used to determine the sensitivity and time response of the polarimetry at 10.6 μm. Measurement of a simulated plasma Faraday rotation demonstrated a sensitivity of approximately 0.01° for a CO_2 laser polarimeter with an electro-optic CdTe crystal modulator.

52861 **Neutral probe beam q-profile measurements in PDX and PBX-M.** Kugel, H.W.; Gammel, G.M.; Kaita, R.; Reusch, M.F.; Roberts, D.W. (Princeton Plasma Physics Laboratory, Princeton University, P. O. Box 451, Princeton, New Jersey 08543). *Review of Scientific Instruments;* **59**: No. 8, 1635-1637(Aug 1988).

Using the fast ion diagnostic experiment technique, a neutral probe beam (NPB) can be aimed to inject tangent to a magnetic

surface. The resultant ion orbit shifts, due to conservation of canonical toroidal angular momentum, can be measured with a multi-sight-line charge exchange analyzer to yield direct measurements of radial magnetic flux profiles, current-density profiles, the radial position of the magnetic axis, flux surface inner and outer edges, q profiles, and central-q time dependencies. An extensive error analysis was performed on previous PDX q measurements in circular plasmas and the resulting estimated contributions of various systematic effects are discussed. Preliminary results of fast ion orbit shift measurements at early times in indented PBX-M plasmas are given. Methods for increasing the absolute experimental precision of similar measurements in progress on PBX-M are discussed.

52862 Measurements of radial profiles of the ion temperature and the plasma rotation velocity with the TFTR vertical x-ray crystal spectrometer (abstract). Bitter, M.; Hsuan, H.; Rice, J.E.; Hill, K.W.; Diesso, M.; Grek, B.; Hulse, R.; Johnson, D.W.; Johnson, L.C.; von Goeler, S.; and others. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543). *Review of Scientific Instruments;* 59: No. 8, 1852-1852(Aug 1988).

The TFTR vertical x-ray crystal spectrometer has now been operating with three crystals and position-sensitive detectors according to the original design specifications. The observed spectra of heliumlike Ti XXI, Cr XXIII, Fe XXV, and Ni XXVII have permitted a detailed comparison with the predictions from atomic theories, and they have provided data on the radial profiles of the ion temperature and toroidal rotation velocity, as well as the radial ion charge-state distribution in TFTR discharges. Central ion temperatures of 20 keV and central plasma rotation velocities of 5 x 10^5 m/s have been recorded from plasmas with auxiliary neutral beam heating. These experimental results are presented. Also discussed are further instrumental improvements, such as the installation of two additional crystals and detectors and the installation of γ and neutron shielding, which will make it possible to measure under full DD and DT operation with 27 MW of neutral beam injection where neutron production rates of 10^{19} neutrons/s are expected.

52863 Radiation-induced conductivity: The high-speed detection of photons and particles (invited) (abstract). Kania, D.R. (Lawrence Livermore National Laboratory, P. O. Box 5508, Livermore, California 94550). *Review of Scientific Instruments;* 59: No. 8, 1890-1890(Aug 1988).

High-speed photoconductors have been used to detect photons from the infrared to gamma rays. Their technology has been extended to new materials and to the detection of particles (radiation-induced conductivity). The new materials include thin films of GaAs and diamond and bulk type IIa insulating diamond which complement previously tested material, bulk InP and GaAs. Thin films offer high speeds and discrimination against penetrating radiation. Insulating diamond is insensitive to visible light (scattered laser radiation). Both properties can be extremely valuable in a laser–plasma environment. In addition, these detectors have been used to detect 14-MeV neutron pulses from laser fusion experiments on the Nova laser. The thermonuclear burn rate and its temporal relationship to the driving laser pulse have been determined with 100-ps time resolution. This work was performed under the auspices of the U.S. DOE by the Lawrence Livermore National Laboratory under Contract No. W-7405-ENG-48.

52864 Scattering-based determination of electron energies and concentrations and gas-kinetic temperatures in the inductively coupled plasma. Marshall, K.A. Bloomington, IN; Indiana Univ. (1987). 318p. University Microfilms Order No. 87-27,513.

Thesis (Ph. D.).

A study was undertaken to determine electron-number densities and energy distributions in the inductively coupled plasma (ICP). This information, which serves to fully characterize electron features in the plasma, was pursued by measuring laser-light Thomson scattering. Thomson scattering is the scattering of incident radiation by free electrons in a discharge. Because electrons in a plasma move with extremely high average velocity, the scattered light is substantially Doppler shifted. If the incident light source possesses a narrow spectral band width, as is the case with a laser, the scattered radiation can be detected as a spectrally-broadened signal centered at the incident laser wavelength. The width of this Doppler-broadened spectrum can then be related to the average velocity of the electrons within th e plasma, and the integrated intensity of the scattered light can be related to the electron concentration in the probed volume. Unfortunately, Thomson-scattering measurements are not easily made; the scattering phenomenon is weak, and a rather complex instrumental system is required. The work described here employed to sequentially designed experimental systems that were used successfully to make Thomson-scattering measurements in the ICP.

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52865 (CONF-760202—, pp 489-493) Occupational health physics at a fusion reactor. Shank, K.E.; Easterly, C.E.; Shoup, R.L. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

Future generation of electrical power using controlled thermonuclear reactors will involve both traditional and new concerns for health protection. A review of the problems associated with exposures to tritium and magnetic fields is presented with emphasis on the occupational worker. The radiological aspects of tritium, inventories and loss rates of tritium for fusion reactors, and protection of the occupational worker are discussed. Magnetic fields in which workers may be exposed routinely and possible biological effects are also discussed.

52866 (CONF-760202—, pp 494-498) Health physics aspects of activation products from fusion reactors. Shoup, R.L.; Poston, J.W.; Easterly, C.E.; Jacobs, D.G. (Oak Ridge National Lab., TN (USA)). 1976. OSTI, P.O. Box 62, Oak Ridge, TN 37831. Order Number TI88900453/JAW.

From 9. topical symposium on operational health physics; Denver, CO, USA (9 Feb 1976).

A review of the activation products form fusion reactors and their attendant impacts is discussed. This includes a discussion on their production, expected inventories, and the status of metabolic data on these products.

52867 (CONF-871007—103) Advanced toroidal facility vaccuum vessel stress analyses. Hammonds, C.J.; Mayhall, J.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. Order Number DE88015276/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The complex geometry of the Advance Toroidal Facility (ATF) vacuum vessel required special analysis techniques in investigating the structural behavior of the design. The response of a large-scale finite element model was found for transportation and operational loading. Several computer codes and systems, including the National Magnetic Fusion Energy Computer Center Cray machines, were implemented in accomplishing these analyses. The work combined complex methods that taxed the limits of both the codes and the computer systems involved. Using MSC/NASTRAN cyclic-symmetry solutions permitted using only 1/12 of the vessel geometry to mathematically analyze the entire vessel. This allowed the greater detail and accuracy demanded by the complex geometry of the vessel. Critical buckling-pressure analyses were performed with the same model. The development, results, and problems encountered in performing these analyses are described. 5 refs., 3 figs.

52868 (DOE/ER/53241—1) Maryland magnetic fusion research program MS spheromak: Progress report September 1986–July 1987. (Maryland Univ., College Park (USA). Lab. for Plasma Research). [1988]. Contract FG05-86ER53241. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88016835/JAW.

This paper discusses the progress on the MS spheromak in the following areas: construction and testing of components, formation, stability, and diagnostics. (LSP)

52869 **(DOE/ER/53244—T2) Operation of an RFP with a modular shell.** Schmid, P.; Robertson, S. (Colorado Univ., Boulder (USA)). Jul 1987. Contract FG02-87ER53244. 8p. (CONF-8707105—3). NTIS, PC A02/MF A01. Order Number DE88017031/JAW.

From International workshop on engineering design of next step reversed field pinch devices; Los Alamos, NM, USA (13 Jul 1987).

A shell having many gaps will allow modular construction of an ignition-scale RFP. Modular shells with cuts every 20{degree} in toroidal angle are being tested on the Reversatron. A very thin shell of 0.3 mm aluminum with a 40 μsec penetration time gives a higher plasma resistance and shorter discharge duration than is obtained with a thick conventional shell. Performance is better than with no shell, however. The experiment is to be repeated with a 1.25 mm modular shell. 6 refs., 5 figs.

52870 **(ILE—8705P) Scalings of implosion experiment for high neutron yield.** Takabe, H.; Yamanaka, M.; Mima, K. and others. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). Oct 1987. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754548/JAW.

A series of experiments focused on high neutron yield has been done with Gekko-XII green laser system. DT neutron yield of 10/sup 13/, pellet gain 0.2 %, and coupling efficiency 5.5 % have been achieved. Based on the experimental data for more than 70 shots, the scaling laws of the neutron yield and the related physical quantities have been studied. The comparison of the experimental neutron yield with that obtained by one-dimensional fluid code has led us to a conclusion that most of the neutron yield produced in the stagnation phase is not observed in the experiment because of fuel-pusher mixing possibly induced by the Rayleigh-Taylor instability. A DT core gain of 5 % has also been obtained. The experimental data plotted in the rhoR-T/sub i/ diagram indicate that for igniting the fuel, the ion temperature is sufficiently high, while the rhoR is less by two orders of magnitude than the required value.

52871 **(ILE—8715P) Observation of visible lights from CO/sub 2/ laser-wiggler.** Kitagawa, Y.; Mima, K.; Fujita, H.; Nakayama, S.; Nakai, S.; Imasaki, K.; Miyamoto, S.; Yamanaka, C.; Ohigashi, N. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754549/JAW.

By counter-injecting a CO/sub 2/ laser beam to a high current relativistic electron beam(REB), a bremsstrahlung radiation is observed, which has two spectral peaks in the wavelength range, 800 {similar←to} 550 nm. One is the conventional undulator radiation. Another peak at about 660 nm is strongly enhanced by the REB-laser interaction due to the resonant enhancement of the refractive index of a singly ionized carbon, which may make the FEL wavelength much shorter. From the observed bremsstrahlung, the FEL gain for the CO/sub 2/ laser wiggler is evaluated to be 6 x 10/sup -6/.

52872 **(INDC(NDS)—201/GF) IAEA specialists' meeting on the fusion evaluated nuclear data library related to the ITER activity.** Goulo, V.; Lorenz, A. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1988. 15p. (CONF-8711217—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703868/JAW.

From Specialists' meeting on the fusion evaluated nuclear data library related to the ITER activity; Vienna, Austria (16 Nov 1987).

This is the summary report of an IAEA Specialists' Meeting on the Fusion Evaluated Nuclear Data Library Related to the ITER Activity, convened by the IAEA Nuclear Data Section in Vienna from 16 to 18 November 1987. The objective of the meeting was to formulate a detailed programme and time schedule for the development of the Fusion Evaluated Nuclear Data Library (FENDL) to meet the future needs of the ITER activity.

52873 **(JAERI—1312) Activation cross section measurements for fusion reactor structural materials at neutron energy from 13.3 to 15.0 MeV using FNS facility.** Ikeda, Yujiro; Konno, Chikara; Oishi, Koji; Nakamura, Tomoo; Miyade, Hiroki; Kawade, Kiyoshi; Yamamoto, Hiroshi; Katoh, Toshio. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 119p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754554/JAW.

Neutron activation cross sections have been measured systematically at energy range from 13.3 to 15.0 MeV utilizing the FNS facility in order to provide substantial nuclear data required in the fusion reactor nuclear design. Up to now, 110 cross section data for reactions of (n, p), (n, n'p), (n, α) and (n, 2n) in 26 elements including major structural materials of iron, nickel, chromium, titanium, molybdenum, etc. were measured in a unified experimental condition. To carry out such many measurements in a short time an efficient γ-ray measuring method was introduced by employing multiple detectors. The all data measured were carefully examined. The incident neutron energies were determined by using a Monte Carlo calculation. Experimental errors were within +-5 % for almost all data used in the dosimetry study as well as data of principal materials. The present data showed significant improvement in accuracy in comparison with previously reported data, therefore the data offer substantial data base to current evaluations of neutron activation cross section.

52874 **(JAERI-M—87-219) Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3. Chapter VIII: blanket and first wall.** Kobayashi, Takeshi; Iida, Hiromasa; Abe, Tadashi and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jan 1988. 348p. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88754555/JAW.

This report includes Japanese contributions presented at INTOR Workshop Phase 2A, Part 3 relevant to the studies of technical critical issues of blanket, first wall, divertor plate and shield designs, and new database concerning these areas. New database for ceramic breeder materials, high heat flux materials, high heat flux experiments and fabrication experience are included. A comparison study of blanket concepts and design studies of candidate blankets have been carried out. The blanket with lithium oxide breeder is selected as the leading blanket concept because of its high breeding performance and good tritium release behavior. Two types of first wall concepts, bare stainless steel first wall concept and protected first wall concepts, are evaluated. For disruptions, the behaviors of crack propagation are examined based on J integrals. The local guard limiter concept with easy maintainability is selected as a reference considering currently rather uncertain disruption scenarios. Tungsten is selected as the reference armor material of divertor plate because of its good thermal and sputtering resistance. The inboard shield thickness has been optimized both for stainless steel material and tungsten material. Blanket engineering test program of FER is also described in this report. Major basic engineering tests on blanket performances such as neutronics, thermal-hydraulics, tritium recovery etc. can be performed by test elements and modules.

52875 **(JAERI-M—88-010) Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3. Chapter VI: electromagnetics.** Kasai, Masao; Ikeda, Bunko; Saito, Ryuta and others. (Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan)). (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 214p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88754556/JAW.

This report corresponds to Chapter VI of Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3, and consists of two parts, i.e. Critical Issues and Innovations. The critical issues contains the analyses on poloidal field coils, operation scenario, closed loop plasma control and plasma disruptions. The innovations contains feasibility studies on high current density and high field for TF coil, use of Nb/sub 3/Sn for PF coils, forced flow subcooled He II superconducting coils, allowable stresses in the struc-

tural material of the magnetic system and non-metallic structural materials, and design guidelines of toroidal field coil sizing.

52876 **(JAERI-M—88-011) Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3. Chapter 7: configuration and maintenance.** Iida, Hiromasa; Kobayashi, Takeshi; Yamada, Masao and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 267p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754557/JAW.

This report corresponds to Chapter VII of Japanese contribution report to IAEA INTOR Workshop, Phase two A, Part 3. The discussions on the following tasks are reported. Task 1. Comparative study of vertical and horizontal access configuration. Task 2. Shape memory alloy. Task 3. Ferromagnetic inserts for ripple reduction. Task 4. PF coil redundancy. Task 5. Rapid replacement of divertor and first wall. Task 6. Containment of tritium and activated dust. In the above tasks, Task 2, 3 and 4 come from the Specialist Meeting on Tokamak Concept Innovation in January, 1986.

52877 **(JAERI-M—88-029) Japanese contribution to INTOR Workshop, Phase IIA, Part 3. Group B: operational limits and confinement.** Tsunematsu, Toshihide; Azumi, Masafumi; Matsumoto, Hiroshi and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88754559/JAW.

This report summarizes the data base on the confinement and the beta limit proposed by Japanese delegation to the INTOR workshop Phase IIA, Part 3 held from September 1985 to December 1987.

52878 **(JAERI-M—88-033) Requirements in the edge for H-mode transitions.** Matsumoto, Hiroshi; Funahashi, Akimasa; Hoshino, Katsumichi and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754560/JAW.

In JFT-2M, conditions for H-mode transitions in the periphery of the plasma were studied. It was found that edge electron temperature does not always determines the H-mode transition. In usual sawtooth triggered H-mode cases, the minimum edge electron temperature needed for H-mode transition decreased with the increase of the electron density. And this edge electron temperature and the density seems to control the transition phenomena in this case. However, there are cases when these parameters are not determining the transition. It was found that the threshold beam heating power for H-mode was found to decrease by lowering the beam acceleration voltage. In this case, the transition took place in lower edge temperature and lower electron density compared with higher beam voltage case. Power deposition calculation shows that the lower energy beam did not preferentially heat edge electrons, instead, it delivered more power to ions in the periphery.

52879 **(JAERI-M—88-045) Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3. Chapter 3: impurity control.** Mizoguchi, Tadanori; Fujisawa, Noboru; Okazaki, Takashi and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 132p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754564/JAW.

This report corresponds to Chapter III of Japanese contribution report to IAEA INTOR Workshop, Phase Two A, Part 3. The major objectives of Impurity Control group during the Phase IIA Part 3 are (1) an assessment of the physics and engineering data base based on current experiments, (2) an evaluation of innovative ideas which would significantly improve the impurity control systems of INTOR-like design, and (3) design studies using sophisticated computational models to extrapolate at the operating parameters. The current data base from JT-60, JFT-2M, JIPPT-IIU and Heliotron E are reported and assessed for INTOR impurity control system. Five innovations are evaluated. Newly developed two-dimensional fluid models are reported. The preliminary design studies found a reasonable divertor operation for the impurity control system of INTOR-like design.

52880 **(JAERI-M—88-046) Observation of flow patterns of vapor-liquid two-phase helium in cryopump glass models.** Shibanuma, Kiyoshi; Araki, Masanori; Dairaku, Masayuki; Ono, Yoichi; Shibata, Takemasa. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 20p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754565/JAW.

The cryopump system for JT-60 NBI consists of fourteen cryopumps. The pumping speed of each cryopump is 1,400 m/sup 3//sec for hydrogen and the total pumping speed of fourteen cryopumps is as large as 20,000 m/sup 3//sec, which is the largest in the world. Each cryopump consists of six modules connected by pipes to supply liquid helium to the six cryopanels. It is necessary to supply liquid helium to the six cryopanels sufficiently in order to evacuate the hydrogen gas stably. We carried out visual experiments to observe the flow patterns of liquid helium in cryopumps for the purpose of confirming usefulness of the pool cooling of the cryopanels by liquid helium. The flow patterns of two-phase helium flow in cryopanels and channels were observed in two type glass models to simulate the cryopump of JT-60 NBI. One is a glass model with a liquid helium supply line for natural circulation, and the other is a glass model without a liquid helium supply line. The two-phase helium flow in the former glass model was homogenious flow, that is, liquid and gas were mixed uniformly, circulating smoothly through cryopanels and pipes. On the other hand, the two-phase helium flow in the latter glass model was separate flow. In this model, there was the unbalance in liquid helium supply to the cryopanels and also discontinuous choke in channels by liquid helium in the counter two-phase flow which prevented smooth release of gas helium from cryopanels at the junctions between pipes and between pipe and phase separator. Therefore, we decided to employ the natural circulation system with a liquid helium supply line for cooling the cryopanels of JT-60 NBI.

52881 (JAERI-M—88-065, pp 75-118) **Evaluation of the fusion-related neutron nuclear data for JENDL-3. Nuclear data in the very light mass resion stored in JENDL-3T.** Chiba, Satoshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

Status of the neutron nuclear data evaluations for JENDL-3 will be described for nuclides important in the development of D-T fusion reactors. In this article, however, only explanation of the evaluations for the very light mass region will be presented to avoid overlapping with what are given in another papers submitted to this seminar. Emphases are placed on the tritium production cross sections, inelastic scattering cross sections including the double-differential neutron emission spectrum (DDX), threshold reaction cross sections and photon production cross sections. The methods employed to prepare JENDL-3T library and their results will be summarized.

52882 (JAERI-M—88-065, pp 198-211) **Fusion neutronics integral test for JENDL-3T.** Maekawa, Hiroshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1988. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88008591/JAW. (NEANDC(J)—127/U; INDC(JPN)—113/L; CONF-8711173—).

From Seminar on nuclear data; Tokai, Japan (12 Nov 1987).

For the formal evauation of the JENDL series nuclear data files in fusion neutronics field, "Subworking Group on Fusion Neutronics Integral Test" was formed among the member of both the Subcommittee on Reactor Constants on the Japanese Nuclear Data Committee and the Subcommittee on Fusion Reactor of the Research Committee on Reactor Physics. The integral test was planned on the basis of results of an enquete. The results of integral tests were reported by seven groups at 24th meeting of Subcommit-

tee on Fusion Reactor held on Oct. 30, 1987. This report is based on the presentations and discussions at the 24th meeting and made comments on the nuclear data of /sup 1/H, /sup 6/Li, /sup 7/Li, /sup 9/Be, /sup 12/C, /sup 16/O, Si, Cr, Fe, Mn, Cu and Pb.

52883 **(JAERI-M—88-068) Energy confinement scaling based on offset linear characteristic.** Odajima, Kazuo; Shimomura, Yasuo. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754566/JAW.

Scaling of energy confinement time for L-mode are obtained based on the offset linear characteristic, in which a total stored energy during the additional heating can be divided into two parts, those are stored energy of ohmic base plasma and incremental stored energy from additional heating. Dependences of ellipticity and plasma minor radius are discussed and the previous work is revised. This scaling has strong dependence on plasma size and predicts weak plasma current dependence in the very high heating power region. Two types of improvement of energy confinement are discussed, i.e. improvement of ohmic base plasma and that of incremental stored energy from additional heating. Each of these improvements increases each energies about two times and in the case that both improvements take place simultaneously, gross energy confinement time can be doubled.

52884 **(JAERI-M—88-081) Lifetime evaluation of first wall and divertor plate by crack analyses during plasma disruptions.** Ohmori, Junji; Kobayashi, Takeshi; Yamada, Masao; Iida, Hiromasa. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). May 1988. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754570/JAW.

The first wall and divertor armor in fusion devices are subjected to high heat and particle fluxes. In particular, disruption heating is an intense thermal shock which may cause melting or vaporization of the armor surfaces. The behavior of the armor materials is one of the major factors limiting the lifetime of these components. Generally the surface temperature of armor due to disruption gets so high that the surface may become cracked. However, even if only the surface of the armor is cracked, the function of the armor will not be lost as long as the damage is limited to within a small depth of the surface. In this study, the lifetime of the armor is evaluated by two stages: crack initiation life and crack propagation life which are related to the fatigue life and the energy release rate, respectively. Materials are graphite and C/C composite (carbon fiber reinforced carbon composite) for the first wall, and tungsten for the dinertor. For disruption conditions of Fusion Experimental Reactor, the fatigue life and the energy release rates are calculated by thermal, and stress analyses. Results show that crack initiation is expected after only a few disruptions, and the energy release rate as a function of the crack length comes up to the maximum value at a small crack length, and decreases with increasing of the crack length. This decreasing means that a crack propagation rate reduces. An unstable fracture does not occur if the maximum energy release rate does not exceed the critical energy release rate which can be obtained from the fracture toughness.

52885 **(KFK—4411) Monte Carlo shielding calculations in the double null configuration of NET.** Fischer, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). May 1988. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754673/JAW.

Multi-dimensional Monte Carlo shielding calculations have been performed for evaluating the shielding performance of the NET reactor components. Biased Monte Carlo techniques, that are available in the MCNP-code, have been applied for describing the neutron and photon transport through the shielding components. A realistic three-dimensional model of a NET torus sector has been used, that takes into account all relevant reactor components adequately. The poloidal variations of the physical quantities relevant for the radiation shielding, the shielding performance of the divertors, and the neutron streaming through toroidal segment gaps and its impact on the shielding performance of the vacuum vessel are the main objects of the analysis. Furthermore, the relations between idealized one-dimensional and realistic three-dimensional shielding calculations are analyzed.

52886 (KFKI—1988-02/D, pp 56-63) **Modernization of the MT-1 tokamak of CRIP. Design and development.** Buerger, Gabor. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jan 1988. (In Hungarian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88703435/JAW.

In Thermonuclear plasma physics research in the Central Research Institute for Physics, Hungary. (1986-1987).

The MT-1 tokamak of CRIP was put into operation in 1979. The experiences of research work with the tokamak led to the claim of the development and modernization of the device. The main goals of the development are: to improve the number of simultaneously connected plasma diagnostic devices, especially the number of horizontal diagnostic channels, and to improve the duration of the plasma discharge by a factor of two. The first step of the modernization required the complete replacement of the tokamak chamber, the removal of the copper covering of the toroid and the implementation of the supplementary electromagnetic coils for dynamical plasma confinement. The design and building of the chamber and high-current and electric supply and control devices are in progress. (D.Gy.) 3 figs.

52887 **(LA-UR—88-2796) The tritium systems test assembly: Overview and recent results.** Bartlit, J.R.; Anderson, J.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880929—1). NTIS, PC A02/MF A01. Order Number DE88016157/JAW.

From 15. symposium on fusion technology; Utrecht, Netherlands (19 Sep 1988).

The fusion technology development program for tritium in the US is centered around the Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory. The TSTA is a full-scale system of reactor exhaust gas reprocessing for an ITER-sized machine. That is, TSTA has the capacity to process tritium in a closed loop mode at the rate of 1 kg per day, requiring a tritium inventory of about 100 g. The TSTA program also interacts with all other tritium-related fusion technology programs in the US and all major programs abroad. This report summarizes the current status, results and interactions of the TSTA. Special emphasis is given to operations in May/June using large compound cryopumps that completed the fuel loop integration of all TSTA subsystems for the first time. 6 refs., 2 figs.

52888 **(NIIEFA-B—0764) Compact tokamak for study on thermonuclear burning.** Astapkovich, A.M.; Vasil'ev, V.I.; Glukhikh, V.A. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 38p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703453/JAW.

The results of preliminary consideration of a compact tokamak with a strong magnetic field designed for achievement and investigation of thermonuclear burning are presented. A model of the compact tokamak with ignition with the following parameters: aspect ratio of plasma filament A-5; the large radius of plasma filament 2.2 m; the small radius- 0.44 m; the diverter-poloidal, two-zero; stretch by the vertical 1.7; current in the plasma filament 3.8 MA; plasma density in the burning regime, average 6-8x10/sup 14/ cm/sup -3/, on the axis 1-5x10/sup 15/ cm/sup -3/; temperature on the axis 10 keV; ignition margin 1-2; heating before ignition by means of ion cyclotron resonance at negligible He/sup 3/ addition addition, f=104 mHz, P/sub HF/=12 MW; heating duration 3-5 s, is considered. Systems of a poloidal field and HF-heating, a discharge chamber and a power supply system are described. Stress-deformed state as well as strength of the electromagnetic system and discharge chamber are considered. 10 figs.; 9 tabs.

52889 **(NIIEFA-P-A—0767) Discharge chamber of a tokamak with strong magnetic field.** Gurin, S.P.; Ermilin, Yu.M.; Karasev, B.G.; Kasatkin, A.I.; Kozlov, A.V.; Konstantinov, Yu.A.; Odintsov, V.N. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703454/JAW.

Operation conditions, design and some questions, related to fabrication of a discharge chamber of a tokamak with a strong magnetic field, are considered. The necessity of adiabatic compression of plasma using external magnetic fields, appears to be the main factor, determining the chamber design, apart from vacuum conditions. The large plasma radius before compression equals to 1060 mm, after it-to 415 mm. The minor radius equals respectively to 320 and 125 mm. To provide for such a regime the chamber cross section is oval and has a peak, directed to the center of a unit. The discharge chamber is a thin-wall steel cladding (0.7 mm thick), devided into 64 sections. Ribs of similar thickness, fixed to a load-bearing unit covering the cladding, which provides for the general stability of plasma, are welded at joint places. 3 figs.

52890 **(NIIEFA-P-B—0724) To the choice of calculating models for analysis of transition electromagnetic processes in azimuthal-sectioned structures of a tokamak-reactor.** Sadakov, S.N.; Filatov, V.V. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703455/JAW.

To analyse transitional electromagnetic process in the tokamak reactor sectioned blanket, a coupled electric circuit approach is used. Comparison of several simplified calculated models of azimuthal-sectioned structures is conducted. The error, introduced by adopted simplifications, is determined, taking the blanket shielding action calculation at the charge start as an example, with the results, obtained using different models, being interpreted as evaluations of different accuracy level for real blanket shielding characteristics. It is shown, that in a typical range of the structure electrotechnical parameter change it is possible to restrict the result error level within the limits of $<10\%$ practically under the same computer short-time memory and machine time requirements, as in the case of axial-symmetric calculated model application. 10 refs.; 8 figs.

52891 **(NIIEFA-P-B—0765) Structure and performance of experimental thermonuclear reactor.** Glukhikh, V.A.; Baranov, G.A.; Belyakov, V.A. and others. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703458/JAW.

State of developing the design of experimental thermonuclear reactor recording, or coding, of the plasma x-ray emission through a multi-silt code (radial slits as well as staggered slits were used); reconstruction, or decoding, to restore a recognizable image of the plasma x-ray emission (the image is two-dimensional or three-dimensional, depending on the type of code used for recording). The characteristics of multi-slit imaging are (a) for both types of codes, a considerable signal-to-noise ratio gain compared with pinhole imaging; (b) tomographic capabilities, but only in the case of the staggered-slit code. For this type of code, two research orientations were developed, focusing respectively on recording (development of new detectors) and the improvement of reconstruction.

52893 **(SAND—88-2249C) LIBRA-A light ion beam fusion reactor conceptual design.** Moses, G.A.; Kulcinski, G.L.; Bruggink, D.; Engelstad, R.; Lovell, E.; MacFarlane, J.; Musicki, Z.; Peterson, R.; Sawan, M.; Sviatoslavsky, I. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880928—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016523/JAW.

From Course and workshop on inertial confinement fusion; Varenna, Italy (6 Sep 1988).

The LIBRA light ion beam fusion commercial reactor study is a self-consistent conceptual design of a 330 MWe power plant with an accompanying economic analysis. Fusion targets are imploded by 4-MJ-shaped pulses of 30 MeV Li ions at a rate of 3 Hz. The target gain is 80, leading to a yield of 320 MJ. The high intensity part of the ion pulse is delivered by 16 diodes through 16 separate z-pinch plasma channels formed in 100 torr of helium with trace amounts of lithium. The blanket is an array of porous flexible silicon carbide tubes with $Li_{17}Pb_{83}$ flowing downward through them. These tubes (INPORT units) shield the target chamber wall from both neutron damage and the shock overpressure of the target explosion. The target chamber is a right circular cylinder, 8.7 meters in diameter. The target chamber is "self-pumped" by the target explosion generated overpressure into a surge tank partially filled with liquid that surrounds the target chamber. This scheme refreshes the chamber at the desired 3 Hz frequency without excessive pumping demands. The blanket multiplication is 1.2 and the tritium breeding ratio is 1.4. The direct capital cost of LIBRA is estimated to be $2200/kWe. 12 refs., 9 figs., 1 tab.

52894 **(UCLA/PPG—1174) In situ spectroscopic measurements of erosion behavior of TFTR-redeposited carbon materials under high-flux plasma bombardment in PISCES-A.** Hirooka, Y.; Pospieszczyk, A.; Conn, R.W.; Labombard, B.; Mills, B.; Nygren, R.E.; Ra, Y. (California Univ., Los Angeles (USA). Inst. for Plasma and Fusion Research). Aug 1988. Contract AS03-84ER52104. 24p. (CONF-881002—5). NTIS, PC A03/MF A01. Order Number DE88017229/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

The chemical erosion behavior of graphite materials pre-exposed in Tokamak Fusion Test Reactor (TFTR) as the bumper limiter has been investigated spectroscopically under deuterium plasma bombardment in the PISCES-A facility. The deuterium plasma bombardment conditions are: ion bombarding energy of 300 eV; ion flux of 1.7 {times} 10^{18} ions s/sup {minus}1/ cm/sup {minus}2/; plasma density of 1.4 {times} 10^{12} cm/sup {minus}3/; electron temperature of 11 eV; and neutral pressure of 3 {times} 10/sup {minus}4/ torr. The chemical erosion yield is measured with CD-band spectroscopy during the temperature ramp from 100 to 900{degree}C at an average rate of about 5 degrees/s. The materials used include virgin POCO AFX-5Q graphite, graphite tile pieces from the redeposition-dominated and erosion-dominated areas of the bumper limiter in TFTR. It has been found in common for these graphite materials that the chemical erosion yield maximizes at a temperature around 550{degree}C. However, graphite from the redeposited area has shown a somewhat higher maximum erosion yield and significantly steeper temperature dependence. In addition, the removability of the redeposited materials by helium plasma bombardment has been studied. The removal rate is found to be similar to the physical sputtering yield of carbon by helium. The surface morphology and surface composition has been analyzed with SEM and EMPA in parallel with these erosion behavior measurements. 38 refs., 5 figs., 1 tab.

52895 **(UCRL—21073) Fusion Applications and Market Evaluation (FAME) study.** Bourque, R.F.; Schultz, K.R. (Lawrence Livermore National Lab., CA (USA); General Atomics Co., San Diego, CA (USA)). Feb 1988. Contract W-7405-ENG-48. 164p. (GA-A—18658). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88014183/JAW.

This report discusses the known applications of fusion energy and estimates possible markets. Because fusion reactors can generate surplus neutrons (10 times greater than fission), other valuable products can be made besides thermal energy for electrical

power. The purpose of this study was to explore the many other products that could result from neutronic interactions, from the volumetric nature of nuclear heating, and from the utilization of electromagnetic and charged particle energy. Even with other products being sold, electricity is the major product of the neutron thermal energy and sale of it is generally required for acceptable economics. Other products that are either unique to fusion or can be generated in great quantities that are otherwise unattainable are: (1) fissile fuels, (2) tritium, (3) radioisotopes, especially ^{60}Co is expected to grow substantially as the food irradiation industry matures. To a limited extent, the fusion neutrons might also be used to transmute fission waste and for radiation testing sources. The thermal energy from fusion reactors can be used for nonelectrical applications such as synthetic fuel production, industrial process heat, and district heating. Inherently safe reactor designs with low activity materials could be sited near the thermal energy user. Finally, in the long term, the high energy content of fusion fuel makes it an interesting possibility as a power source for deep space missions.

52896 **Conceptual design and neutronics analyses of a fusion reactor blanket simulation facility.** Beller, D.E.; Ott, K.O.; Terry, W.K. (Purdue Univ. (US)). *Nuclear Science and Engineering;* **97**: No. 3, 175-189(Nov 1987).

A new conceptual design of a fusion reactor blanket simulation facility has been developed. This design follows the principles that have been successfully employed in the Purdue Fast Breeder Blanket Facility (FBBF), where experiments have resulted in the discovery of substantial deficiencies in neutronics predictions. With this design, discrepancies between calculation and experimental data can be nearly fully attributed to calculation methods because design deficiencies that could affect results are insignificant. The conceptual design of this FBBF analog, the Fusion Reactor Blanket Facility, is presented.

99 GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 51388

9901 Management

REFER ALSO TO CITATION(S) 50572, 50827, 51078, 51382, 51915, 52943

52897 **(DOE/EH—0060) Management appraisal of the San Francisco Operations Office quality assurance program: September 17--25, 1987.** (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC. Office of Quality Assurance). Mar 1988. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016375/JAW.

A QA management appraisal was preformed of the San Francisco Operations Office (SAN) during the period of September 17-25, 1987. The objective of the appraisal was to determine the adequacy and the extent to which the SAN quality assurance program has been developed, documented and implemented. Within SAN, quality achievement is assigned as a line management responsibility with technical support and program oversight assigned to ESQA, the QA staff function. These responsibilities are documented in SAN management directives. Discussions with SAN personnel indicate they understand and accept their responsibilities. Of concern, however, is the lack of progress within SAN toward having line managers fulfill their assigned QA responsibilities without almost total reliance on ESQA staff. This dependence for QA support has placed a burden on the limited QA staff to the detriment of fulfilling their responsibilities for overview of QA. As a consequence, ESQA has been unable to implement the QA program and to initiate actions to institutionalize the QA program within SAN and SAN contractor organizations. Several of the deficiencies noted in the 1983 QQA Summary of the SAN QA program remain open. The deficiency to provide QA training to SAN line managers has not been closed. Also, internal QA audits are not being performed. These findings were not formally tracked within SAN. No mechanism is in place to routinely and formally alert upper management that corrective actions are not being completed. 23 refs.

52898 **(DOE/MA—340) Occupant Emergency Plan [OEP]: James Forrestal Building.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Engineering and Facilities Div.). Sep 1988. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016529/JAW.

This is the occupant emergency plan for the James Forrestal Building. It contains the following information: codes of federal regulations; evacuation information; building re-entry information; emergency call lists; floor plans; evacuation routes; fire hydrant locations; and bomb threat procedures. (DM)

52899 **(EGG-M—37687) A productivity measurement system.** Sweet, R.H.; Blain, D.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 19p. (CONF-8804175—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015121/JAW.

From American Institute for Design and Drafting meeting; San Jose, CA, USA (21 Apr 1988).

The system for measuring productivity of the EG and G Idaho, Inc., Drafting Group was developed at the Idaho National Engineering Laboratory. The Productivity Measurement System, built on relational data base management software, provides up-to-date information on the productivity of the Drafting Group, the drafting units, and the individual Drafters. The system was developed using data collected in the Drafters Time and Activities Log and Task Baseline Agreement (TBA) that was input to the data base. Using these data, an average usage rate in hours per square foot of drawing, CAD and Manual, was established. This provided a benchmark for management reports that are depicted graphically for ease of trend analyses. In addition, the system provides each drafter an indicator as to where they stand in relation to their peers, and all of the information provided leads to more accurate drafting estimates. 11 figs.

52900 **(IAEA-TECDOC—447(2.ed)) Radioactive waste management glossary.** (International Atomic Energy Agency, Vienna (Austria)). Jan 1988. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704109/JAW.

The Waste Management Glossary defines over 300 terms in the English language that have special meanings when they are used in the context of radioactive waste management. The Glossary is intended to provide a consistent reference for these terms for specialists in this field. It also will assist non-specialists who read IAEA reports dealing with waste management. This is the second edition of the Glossary. It is intended to update and replace its predecessor, TECDOC-264, that was issued in 1982.

52901 **(IAEA-TECDOC—449) OSART guidelines. Reference document for IAEA Operational Safety Review Teams (OSARTs).** (International Atomic Energy Agency, Vienna (Austria)). Feb 1988. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704110/JAW.

The IAEA Operational Safety Review Team (OSART) programme provides advice and assistance to Member States to enhance the operational safety of nuclear power plants. These OSART Guidelines provide overall guidance for the experts to ensure the consistency and comprehensiveness of the operational safety review. Specific guidelines are provided as guide for the systematic review in the following areas important to operational safety: management, organization and administration, training and qualification, operations, maintenance, technical support, radiation protection, chemistry, emergency planning and preparedness.

52902 **(SAND—87-2899C) Management by the manager, decisions by the team: Leadership style for the future, or just a hopeless muddle?.** Furaus, J.P.; Shirley, C.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-8809110—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015618/JAW.

From Project Management Institute symposium; San Francisco, CA, USA (17 Sep 1988).

A characteristic of team implementation of projects is some type of participatory decision-making. Opinions differ on whether this is a valuable tool for project managers or whether it is only a management fad that blurs accountability. This paper recounts experience and offers observations about the effectiveness of participatory decision-making in project management. The basis of the paper is approximately a decade of projects in construction of specialized facilities for research and development (R&D) at Sandia National Laboratories in Albuquerque, New Mexico. Over the time we have developed a participatory style that distributes a balance of authority and accountability. It is a style that has worked well in our environment and is evidence that shared decision-making can be made to work. 4 figs.

52903 **(SAND—87-2964) Photometrics property control system.** Phipps, G.S. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. Contract AC04-76DP00789. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016854/JAW.

The Property Control System used by the Photometrics Division is described. Data from this system are used to keep track of the thousands of items currently in the division inventory. Reasons for a Property Control System, its intended benefits, hardware and software requirements, organization of the database, philosophy of use, and operational details are included. 3 refs., 26 figs.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 51833

52904 **(ANL/MCS-TM—108) The BLAZE family of languages: Programming environments for shared and distributed memory architectures.** Mehrotra, P.; Van Rosendale, J. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Jun 1988. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016468/JAW.

Designing software environments for parallel computers is a central issue in parallel computing research. This paper discusses this issue and the alternate approaches to resolving it which are being studied. We also look at the way in which the type of parallel architecture constrains the design of the programming environments. Shared memory multiprocessors provide the most freedom in the design of effective programming environments, but are more costly than nonshared memory architectures of comparable power. After this general discussion, we describe two new parallel programming languages, BLAZE 2 and KALI. The first of these, BLAZE 2, is a high level language for shared memory multiprocessors. The second, KALI, is a moderately high-level language for distributed memory architectures. We conclude with a brief discussion of the differences between these two languages, which are a consequence of the difference between shared and non-shared memory multiprocessors. 13 refs., 3 figs.

52905 **(ANL/MCS-TM—113) Computational dynamic programming for stochastic optimal control on a vector multiprocessor.** Hanson, F.B. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Jun 1988. Contract W-31109-ENG-38. 28p. (CONF-871251—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016469/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

Numerical methods have been developed to solve optimal feedback control problems for nonlinear, continuous time dynamical systems, perturbed by Poisson as well as Gaussian random white noise. Predictor-corrector methods have been modified for the functional partial differential equation of stochastic dynamic programming to treat nonlinearities attributable to quadratic costs and nonsmoothness attributable to control switching as well as Poisson-induced delays. Uniform corrector convergence conditions are given for the multistate case. This numerical formulation is highly suitable for vectorization and parallelization techniques. These techniques have resulted in speedups of 120 times for the Argonne National Laboratory's Alliant FX/8 vector multiprocessor over a VAX 11/780, when applied to a multistate, multicontrol resource model. Speedups are greater the finer the mesh becomes, because of the dominance of concurrent-outer, vector-inner loops. Column-oriented code can run more than twice as fast as row-oriented code for highly refined meshes, but row-oriented code is more efficient and perhaps practical for coarser meshes. An analytical model of the primary loop structure yields a concurrent-outer, vector-inner loop dominant limit. Addition memory overhead is encountered in performance measurements for large mesh sizes. Advance computing techniques and hardware help alleviate Bellman's "curse of dimensionality" in dynamic programming computations. 48 refs., 8 figs.

52906 **(ANL/MCS-TM—124) Effective utilization of OR-parallelism: A modest proposal.** Lusk, E.L.; Overbeek, R.; Sterling, L. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Jun 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number DE88016887/JAW.

The Gigalips Project is in the process of producing a Prolog system capable of supporting OR-parallel execution. One explicit goal of that effort is to support sequential Prolog semantics, while exploiting the benefits offered by OR-parallel execution on shared-memory multiprocessors. This goal originated from a desire to retain the body of existing programs, while exploring the benefits of parallel execution. In this document, we present an alternate goal, which we believe is substantially less ambitious. We present a programming style that we advocate for expressing algorithms in prolog. For programs written using the advocated style, the exploitation of OR-parallelism is both natural and straightforward; the thorny issues involved in successfully executing arbitrary Prolog programs in an OR-parallel environment simply disappear. Furthermore, it is our belief that the style we advocate is a natural means for expressing algorithms that might benefit from execution in an OR-parallel environment. 3 refs.

52907 **(BNL—41258) VAX CLuster upgrade: Report of a CPC task force.** Hanson, J.; Berry, H.; Kessler, P.; Littenberg, L.; Tichler, J.; Watson, W. (Brookhaven National Lab., Upton, NY (USA)). May 1988. Contract AC02-76CH00016. 19p. NTIS, PC A03/MF A01. Order Number DE88016902/JAW.

The CSCF VAX cluster provides interactive computing for 100 users during prime time, plus a considerable amount of daytime and overnight batch processing. While this cluster represents less than 10% of the VAX computing power at BNL (6 MIPS out of 70), it has served as an important center for this larger network, supporting special hardware and software too expensive to maintain on every machine. In addition, it is the only unrestricted facility available to VAX/VMS users (other machines are typically dedicated to special projects). This committee's analysis shows that the cpu's on the CSCF cluster are currently badly oversaturated, frequently giving extremely poor interactive response. Short batch jobs (a necessary part of interactive work) typically take 3 to 4 times as long to execute as they would on an idle machine. There is also an immediate need for more scratch disk space and user permanent file space.

52908 **(CONF-880850—11) Expert systems "to go": Laptop personal computers and knowledge-based software.** Carr, K.R. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016351/JAW.

From American Institute of Chemical Engineers summer national meeting; Denver, CO, USA (21 Aug 1988).

There are many instances in the everyday activities of many fields in which the physically small, lightweight, battery-powered laptop personal computer with appropriate knowledge-based software can be a highly beneficial tool. For example, in chemical engineering field work, the easily portable laptop personal computer with expert system programs can provide expert assistance in troubleshooting equipment, tuning controllers, and installing various components. Laptop personal computers fill a particular niche in the use of knowledge-based software; at the Oak Ridge facilities of the US Department of Energy, knowledge-based software is being used on a wide range of computers, including a Cray X-MP/12,

Digital Equipment Corp., VAX 8700, VAX 8200, and VAXstations, Symbolics, Inc., 3640 LISP machines, many IBM PC's and compatibles, as well as laptop personal computers. Factors considered include expert system transfer from larger computers, program execution speed, memory capacity, and options for utilization of non-volatile memory storage. 46 refs.

52909 **(CONF-8607100—) NEUROCON-1: Proceedings.** Dress, W.B. (ed.). (Oak Ridge National Lab., TN (USA)). May 1988. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88013108/JAW.

From NEUROCON 1 conference; San Jose, CA, USA (27 Jul 1986).

Five presentations dealing with state of the art research in computerized simulation of neural networks are presented. These contributions are indexed and abstracted separately.

52910 **(DOE/EIA—M-032) A model maintenance and generation system: System manual.** Orchard-Hays, W. (USDOE Energy Information Administration, Washington, DC). Jun 1988. 137p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88015774/JAW.

The MDMS30 system includes five separate procedures. The term "procedure" is used here to denote a complete program which is embodied in a member of a LOAD library and executed as a separate job step. Two of the five procedures, PARSE and MDMEXEC, are essential components in all uses of MDMS30. A third procedure, MDMINPUT, is required whenever MDMS30 is used to generate a linear programming (LP) model, one of its chief functions. The other two procedures, MDMMERGE and EXTRACT, provide advanced features for use with LP models. Additionally, the HLP30 LP system is required, at least in part, for all LP models generated by MDMS30. This manual is concerned primarily with MDMEXEC and secondarily with PARSE. MDMS30 is programmed by the user in a language which is fully explained in the MDMS30 USERS manual. A reader should be thoroughly familiar with that manual before attempting to read this one. A program written in the user's language must be processed by PARSE before it can be excuted by MDMEXEC. PARSE is a kind of half-compiler which translates the user's language into a compact and easily excuted form which, nevertheless, is still interpretive. The PARSE procedure is very fast and is treated essentially as a compiler. However, full compilation is not appropriate to a language such as that of MDMS30. MDMEXEC is also fast in almost all respects in spite of its interpretive nature.

52911 **(DOE/OR—884-Rev.1) University program in robotics for advanced nuclear reactors: Program plan, FY 1987-FY 1992.** Mann, R.C.; Gonzalez, R.C.; Tesar, D.; Tulenko, J.S.; Wehe, D.K. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Electrical and Computer Engineering; Texas Univ., Austin (USA). Dept. of Mechanical Engineering; Florida Univ., Gainesville (USA). Dept. of Nuclear Engineering Sciences; Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Jul 1988. Contract AC05-84OR21400. 142p. (ORNL/M—370-R1). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88015361/JAW.

The US Department of Energy has provided support to four universities and the Oak Ridge National Laboratory in order to pursue research leading to the development and deployment of advanced robotic systems capable of performing tasks that are hazardous to humans, that generate significant occupational radiation exposure, and/or whose execution times can be reduced if performed by an automated system. The goal is to develop a generation of advanced robotic systems capable of economically performing surveillance, maintenance, and repair tasks in nuclear facilities and other hazardous environments. The strategy adopted in order to achieve the program goals in an efficient and timely manner consists in utilizing, and advancing where required, state-of-the-art robotics technology through close interaction between the universities and the manufacturers and operators of nuclear power plants. There is a potentially broad range of applications for the robotic systems developed in the course of this project. Therefore, it is expected that efforts to obtain additional support from other agencies, e.g., DOD and NASA, will be successful. Areas of cooperation with other nations (e.g., Japan, France, Germany) are being explored.

52912 **(EGG-M—88110) Project accounting on a large-scale UNIX system.** Gray, W.H.; Powers, A.K. (EG and G Idaho, Inc., Idaho Falls (USA)). [1988]. Contract AC07-76ID01570. 14p. (CONF-8809114—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015120/JAW.

From Workshop on UNIX and supercomputers; Pittsburgh, PA, USA (26 Sep 1988).

Users of large-scale, scientifically-oriented, time-shared systems generally need project style accounting; i.e., engineers and scientist may, and usually do, work on more than one project with more than one funding source. Hitherto, in UNIX systems, the only way to account for such separate usage by one user has been to provide him/her with multiple user-id's. This strategy has some disadvantages which are cheaply ameloirated with the relatively straightforward approach described here.

52913 **(EGG-M—88221) ADABAS on-line security system.** Fitch, R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 15p. (CONF-8809112—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015183/JAW.

From International software AG users group; Nashville, TN, USA (25 Sep 1988).

The Data Base Administration (DBA) team at EG&G Idaho, Inc. has developed an ADABAS ON-LINE SECURITY SYSTEM (AOSS). This system allows on-line access and control of all aspects of ADABAS security (i.e., file, field, password, and security-by-value). Development of this system started with the acquisition of the FILE MAINTENANCE SYSTEM from the University of Texas. By adapting this series of programs to our environment, EG&G gained the ability to interactively control and display ADABAS security at the file, field, and password level. We then developed additional programs that allow users to add, delete, update, and display security by value rules. EG&G's Application Architecture system toolbox provided help text, extended error messages, menus, program control, and inter-application transfer and communication capabilities at the touch of a "PF" key. This system toolbox also allowed transparent low-level access control to ADABAS records. The programs use this access control to ensure that users can't modify the security profile or grant file access for files which they do not "own." The user has a variety of options that allow specification of the ADABAS security rules by entering only the WHAT, not the HOW. The programs will read the user entered data, perform extensive error checking, supply any missing values, and then generate the appropriate security rules using the correct codes and syntax. These rules are then incorporated into batch JCL that is automatically created and submitted. The batch process will update the actual ADABAS security file using the ADASCR module.

52914 **(JAERI-M—88-017) Vector-Parallel processing of the successive overrelaxation method.** Yokokawa, Mitsuo. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Feb 1988. 59p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88754558/JAW.

Successive overrelaxation method, called SOR method, is one of iterative methods for solving linear system of equations, and it has been calculated in serial with a natural ordering in many nuclear codes. After the appearance of vector processors, this natural SOR method has been changed for the parallel algorithm such as hyperplane or red-black method, in which the calculation order is modified. These methods are suitable for vector processors, and more high-speed calculation can be obtained compared with the natural SOR method on vector processors. In this report, a new scheme named 4-colors SOR method is proposed. We find that the 4-colors SOR method can be executed on vector-parallel processors and it gives the most high-speed calculation among all SOR methods according to results of the vector-parallel execution on the Alliant FX/8 multiprocessor system. It is also shown that the theoretical optimal acceleration parameters are equal among five different

ordering SOR methods, and the difference between convergence rates of these SOR methods are examined.

52915 **(JINR—R-10-87-541) NSHR spectrometer software (texture variant). Discription of CGD graphic computer code.** Walther, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88703413/JAW.

Submitted to Conference on investigation of condensed media on the IBR-2 reactor, Dubna, 15 - 17 Sep 1987.

The present paper may be used as a user's guide for working with the graphic computer code. This code is written in the Pascal high level language and is intended for graphic representation of experimental data, such as time-of-flight spectra on a colour display. This computer code runs under the operator system RT-11 on small computers (like SM-3, SM-4, SM-1300 a.o.). The program enables the representation of some spectra simultaneously, to change the parameters of representation, the representation of spectra in a three-dimensional manner, and to keep representation as hard-copy. Further it is possible to use a cursor on the graphic. 4 refs.; 1 tab.

52916 **(JINR—R-10-87-638) Software of data acquisition and transmission system on the base of the Electronika-60 microcomputer operating on-line with the ES computer.** Bazylev, S.N.; Nikiforov, A.S.; Smirnov, V.A.; Trofimov, V.V.; Shutova, N.A.; Kim Men Gyn. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88703415/JAW.

Submitted to the International conference Computer technique-87 (Magdeburg, GDR, 1987).

Hardware and software system used for organization of parallel on-line experiments are considered. This system consists of ES-computer connected with a micro-computer. Data formats and transfer protocol are described. The main advantage of described system are formulated. 3 refs.

52917 **(LA-UR—88-2832) Second-order accurate difference schemes on highly irregular meshes.** Manteuffel, T.A.; White, A.B. Jr. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-8806194—2). NTIS, PC A02/MF A01. Order Number DE88016148/JAW.

From 5. international conference on boundary and internal layers; Shanghai, China (20 Jun 1988).

In this paper compact-as-possible second-order accurate difference schemes will be constructed for boundary-value problems of arbitrary order on highly irregular meshes. It will be shown that for equations of order (K) these schemes will have truncation error of order (3{endash}K). This phenomena is known as supraconvergence. 7 refs.

52918 **(LBL—25428) Final report on the Department of Energy ADPE/DS review panel.** Konrad, A.M.; Johnson, M.; Sharp, S. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 53p. NTIS, PC A04. Order Number DE88016630/JAW.

As mandated by Congress, the General Services Adminstration maintains an inventory of computer equipment belonging to the Federal Government. It is referred to as ADPE/DS. All agencies are required to contribute information to ADPE/DS. In 1987, GSA began a review of ADPE/DS to find ways to make the reporting more accurate and therefore more useful. In the fall of 1987, DOE orgainized the ADPE/DS Review Panel to provide input to the GSA review process. The Panel traced the chain of authority to evaluate the extent to which the implementation of ADPE/DS matched the intent. Numerous issues regarding both GSA and DOE requirements and procedures for information gathering were discussed. The Panel is concerned that the burden of ADPE/DS is disproportionate to its usefulness. Of even greater concern, however, is the apparent absence of a clear understanding by GSA of the need for specific data. Planners of data systems, such as with GSA's ADPE/DS, often try to increase accuracy by collecting much detail. The Panel suspects that ADPE/DS collects far more data than required to obtain the information and knowledge apparently sought. Participating GSA staff agreed that GSA should determine what data is truly vital to its mission. Though participating GSA staff agreed that this is the reasonable next step, it appears that this process is stalled. Therefore, lacking any justification from GSA for the need for specific data, the Panel has formulated recommendations to DOE based on the belief that the spirit of the Public Law can be met by collection of a simple CPU listing from each site. The Panel also examined the internal DOE information-transmission procedures and determined that some are the cause of wasted effort. Recommendations to alleviate these problems are oriented to relieving ADPE/DS sites of the burden of maintaining accounts on the Germantown computing system.

52919 **(LBL—25634) Building a prototype expert systems.** Kalmus, D.; Hutchinson, M.; Hall, D. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88016665/JAW.

In the past few years expert system technology has been gaining increasing respect within the world of computer science as it offers practical solutions to problems which have previously defied computerization. This paper is the culmination of a years investigation into how LBL can practically make use of this technology to solve some of the problems being faced by its scientists. To establish this and gain a greater understanding of expert system technology we attempted to build a prototype expert system using a commercially available expert system shell. The application we chose was to troubleshoot the hardware of the TPC particle detector (used by high energy physicists at LBL) using Neuron Data's expert system shell, Nexpert. This paper gives some brief overviews of the theoretical and practical work done by other people in fields relevant to this project. It includes: expert systems, their development, diagnostic expert systems, and examples of expert systems built to troubleshoot electronic devices. We describe how we selected our prototype expert system and then how we went about designing and building it. For this we have detailed the knowledge necessary to start troubleshooting the TPC and the methods used to represent that knowledge within the expert system shell. Finally we discuss the understanding of expert system technology which we have gained during this project and why we believe that this technology has a place in the future of problem solving at LBL. 31 refs.

52920 **(LBL-PUB—3060) User's guide for the SSC ADDRESSES database system: Version 1.0.** Konrad, A. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016664/JAW.

The SSC ADDRESSES database was implemented at the request of the Superconducting Super Collider Design Group for management of mailing lists. However, it is generalized system that can serve for administration of other mailing lists as well. It allows for domestic and foreign address elements, and electronic mail addresses which could be used by a SPIRES protocol to send CMS mail or files automatically. It has a format to produce adhesive mailing labels, and employs phantom structures in the LISTS subfile to give an immmediate list of addressees on a particular mailing list. There is no practical limit to the number of mailing lists specifiable, nor to the length of the name of a list. The Stanford Public Information Retrieval System (SPIRES) is a product of Leland Stanford Junior University in Palo Alto, CA. The SPIRES database management system at LBL runs on the UC Berkeley Campus IBM 3081-D32 under the VM/CMS operating system. VM SPIRES consists of three components: SPIRES itself (database management system); CMS (the operating system that manages the computer); and SPIRES/CMS interface (maps SPIRES activity onto the CMS environment). Normally, SPRIES users are not and need not be concerned with the subsystems between themselves and SPIRES. The diagram is provided only to demonstrate context. Most of the icons are self-explantory. The purpose of the SERIES/1 is to make the user's ASCII terminal appear as an IBM 3270 terminal to the IBM 3081, and to make the IBM 3081 appear to communicate in ASCII to the user. Section II describes the commands to move along the path from terminal through the gateways into SPIRES. This generally requires less than 10 seconds and becomes routine.

52921 **(PB—88-222864/XAB) Benchmarks to supplant export FPDR (Floating Point Data Rate) calculations.** Bailey, D.; Brooks, E.; Dongarra, J.; Hayes, A.; Lyon, G. (National Bureau of Standards (ICST), Washington, DC (USA). Advanced Systems Div.). Jun 1988. 20p. (NBSIR—88/3795). NTIS, PC A03/MF A01.

Because modern computer architectures render application of the FPDR (Floating Point Data Processing Rate) increasingly difficult, there has been increased interest in export evaluation via actual system performances. The report discusses benchmarking of uniprocessor (usually vector) machines for scientific computation (SIMD array processors are not included), and parallel processing and its characterization for export control.

52922 **(PB—88-226832/XAB) Fuji electric journal, Vol. 61, No. 4, 1988.** (Fuji Electric Co. Ltd., Tokyo (Japan)). 1988. 81p. NTIS, PC E04/MF A01.

Text in Japenese with English abstracts. See also PB—88-226840 and PB—88-151451; Portions of this document are not fully legible.

The journal reports on aspects of computer-aided control systems, such as interactive software SAPL, positioning using performance function, EIXAX artificial intelligence tool, workstations for artificial intelligence, advanced control application and simulation, gain scheduling of the two-direction adaptive control system GISTLAX, fuzzy-rule information processing tool, structuring tool for material flow. It presents articles on specific applications of control systems, such as in waterworks, observers for industrial plants, closed-type OG systems, cement plants, synchronous generators, sewerage inflow processes, expert systems for energy conservation, and continuous annealing.

52923 **(SAND—88-1209) AMCS [Alarm Multiplexer Communications System] user's manual.** Herrera, G.V. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1988. Contract AC04-76DP00789. 142p. NTIS, PC A07. Order Number DE88016499/JAW.

This manual provides users of the Alarm Multiplexer Communications System (AMCS) with sufficient information to set up and check out AMCS and to write an AMCS interface for a host computer or maintain an existing AMCS-to-host interface. Detailed information on hardware installation and checkout procedures, messages, configuration, sensor monitoring, flow control, and fault modes are included. 53 figs., 5 tabs.

52924 **(SAND—88-1279) SAVI: A PC-based vulnerability assessment program.** Matter, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1988. Contract AC04-76DP00789. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016500/JAW.

SAVI (Systematic Analysis of Vulnerability to Intrusion) represents a new generation of analysis programs, which assess the vulnerability of a physical protection system and are designed for use on personal computers. Features unique to SAVI include (1) analysis of all adversary paths, (2) a safeguards-component catalog with a detection/delay performance database, (3) results in graphic form, and (4) path-upgrade recommendations. The primary figure of merit calculated for system effectiveness is the probability of adversary interruption before mission completion. SAVI has been taught to more than 200 security analysts from the US Department of Energy and is currently its standard tool for outsider-threat vulnerability analysis. 8 figs.

52925 **(SAND—88-1431) ALGEBRA: A program that algebraically manipulates the output of a finite element analysis (EXODUS version).** Gilkey, A.P. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016864/JAW.

The ALGEBRA program allows the user to manipulate data from a finite element analysis before it is plotted. The finite element output data is in the form of variable values (e.g., stress, strain, and velocity components) in an EXODUS database. The ALGEBRA program evaluates user-supplied functions of the data and writes the results to an output EXODUS database which can be read by plot programs. 8 refs.

52926 **(SAND—88-2135) Software development/support methodology.** Lemke, P.A.; Benson, M.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016498/JAW.

This report describes all development and software maintenance projects within the Computer Organization, with the exception of administrative applications in Department 2620. Though the report is very similar to a software development project, the principles described are applicable to projects beyond the software confines. Because the application of software engineering to maintenance is new, it is currently more practical to depend on rationale than on hard rules. As we gain experience with the application of software engineering, a more effective methodology will emerge; future versions of this document will incorporate better rules. As a result, our methodology will become easier to understand and to apply. 14 refs., 4 figs.

52927 **(SAND—88-8941) An overview of the computer aided design system for drafting at Sandia National Laboratories, Livermore.** Koopmann, B.E. (Sandia National Labs., Livermore, CA (USA)). Aug 1988. Contract AC04-76DR00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016866/JAW.

Sandia Laboratories Livermore is converting the existing Computervision CADS system to a new hardware and software platform. This report describes the final configuration (after the conversion is completed) and the individual units comparing the system. A background describing the evolution of CADS at SNLL is appended.

52928 **(SLAC-PUB—4676) Fitting functions to noisy data in high dimensions.** Friedman, J.H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1988. Contract AC03-76SF00515. 41p. (CONF-8804183—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015922/JAW.

From 20. symposium on the interface: computing science and statistics; Washington, DC, USA (20 Apr 1988).

Consider an arbitrary domain of interest in n-dimensional Euclidean space and an unknown function of {ital n} arguments defined on that domain. Suppose we are given the value of the function (perhaps perturbed with additive noise) at some set of points. The problem is to find a function that provides a reasonable approximation to the unknown one over the domain of interest. This paper presents a brief review of current methodology aimed at dealing with this problem, and presents a new technique - multivariate adaptive regression splines - that has the potential to overcome some of the limitations of previous approaches. 29 refs., 2 figs., 4 tabs.

52929 **(SOL—88-4) A practical anti-cycling procedure for linear and nonlinear programming:.** Gill, P.E.; Murray, W.; Saunders, M.A.; Wright, M.H. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jul 1988. Contract FG03-87ER25030. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016684/JAW.

A new method is given for preventing the simplex method from cycling. Key features are that a positive step is taken at every iteration, and nonbasic variables are allowed to be slightly infeasible. There is no additional work per iteration. Computational results are given for the first 53 test problems in {ital netlib}, indicating reliable performance in all cases. The method may be applied to active-set methods for solving nonlinear programs with linear constraints. 34 refs., 5 figs., 3 tabs.

52930 **(SOL—88-14) Interior-point methods for linear programming: A challenge to the simplex method.** Gill, P.E.; Murray, W.; Saunders, M.A. (Stanford Univ., CA (USA). Dept. of Operations Research). Jul 1988. Contract FG03-87ER25030. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016686/JAW.

The world of mathematical programming has seen a remarkable surge of activity following publication of Karmarkar's projective algorithm in May 1984. A review of the ensuing three years

has already appeared. One year later, we review some of the main methods and surrounding events, and focus on references that contain computational results. 42 refs.

52931 **(SOL—88-15) Dynamic pricing criteria in linear programming.** Klotz, E.S. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jul 1988. Contract FG03-87ER25028. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88016687/JAW.

In recent years the interest in linear programming algorithms has increased greatly due to the discover of new interior-point methods. New results have also prompted researchers to reconsider some previously discarded ideas in light of their additional knowledge. This thesis begins with a study of some variants of the reduced-gradient method applied to linear programs. Preliminary computational tests revealed how sparsity and degeneracy, two characteristics present in most practical problems, can severely inhibit such variants. The development of dynamic pricing criteria to exclude certain columns from the search direction provides a computationally efficient way to alleviate these difficulties. Application to the simplex method yields a pivot rule designed to avoid degenerate pivots. Generalization of the rule yields a cheap methods to estimate the step lengths associated with potential incoming nonbasic variables. The result is a set of pivot rules that appear particularly useful on highly degenerate and poorly scaled linear programs. Extensive computational tests are presented. 54 refs., 20 figs.

52932 **(UCID—21482) ALPAL: A tool for the development of large-scale simulation codes.** Cook, G.O. Jr. (Lawrence Livermore National Lab., CA (USA)). 22 Aug 1988. Contract W-7405-ENG-48. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88016044/JAW.

This document introduces A Livermore Physics Applications Language (ALPAL), a new computer language developed by the author. ALPAL is geared for use by expert computational physicists as a significant aid in building complex simulation programs. Notably, ALPAL generates almost all of the Fortran code needed to carry out the simulation indicated by the physics model that is given as input. However, ALPAL is a research code, and as such, many more capabilities are being added to it, including extending its ability to generate code for other parts of a physics simulation program. In order to make the importance of this new language very clear, this report includes a survey of some of the languages and tools that have been developed to aid the computational physicist in simulation work. When the capabilities of these languages are examined, it becomes clear that the powerful new language ALPAL has broken significant new ground. 32 refs., 2 figs.

52933 **(UCRL—21078) Procedures for processing satellite-transmitted weather data: Conversion of data from the HP [Hewlett-Packard] computer to the IBM PC system.** Johnson, V.M. (Lawrence Livermore National Lab., CA (USA); Johnson (Virginia M.), Hayward, CA (USA)). 30 Jun 1988. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016193/JAW.

Since 1982, weather data from three sites in the Marshall Islands have been transmitted by satellite, retrieved by a local communications program, and stored on disk. Occasionally, descriptive reports were generated displaying rainfall and insolation data from this database. Both the data storage and processing programs resided on a Hewlett-Packard desktop computer system no longer in use by researchers in Environmental Sciences. Furthermore, the format and processing of data over the six years the system has been in operation have not been consistent. The goals of this conversion project were to document the existing data formats, develop processing program(s) capable of managing the various formats, and establish procedures for the continuing transfer of new data from the GOES system in Virginia to its final storage on an IBM PC system. To achieve these goals, the following materials were developed: the computer program MITRANS, which translates raw data retrieved by the old communications program into edited, self-documenting files organized by site and year, nineteen consolidated data input files, which contain all data from 1982 to May 31, 1988, a comprehensive data dictionary, reflecting all that is known about the 13 different data formats that have been used over the last 6 years, procedures for managing the communications program still running on the Hewlett-Packard computer and transferring its raw data files to the IBM PC, sample input and output files that test the various data formats, and this project report and reference manual. 20 figs., 3 tabs.

52934 **(UCRL—21106) High-bandwidth/low latency temporary storage for supercomputers.** Swensen, J.A. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA). Computer Science Div.). Dec 1987. Contract W-7405-ENG-48. 204p. (UCB/CSD—87/383). NTIS, PC A10/MF A01. Order Number DE88016981/JAW.

The traditional use of memory and symmetrical set of registers for storage of temporary results of scientific programs requires more execution time, hardware, and instruction-stream bandwidth than necessary. Novel register organizations that can be easily integrated into traditional supercomputer architectures can reduce all of these requirements. Execution speed can be more than doubled by storing temporary results in an asymmetrical set of general-purpose registers or an asymmetrical set of vector registers, instead of in memory and a small register-set. Faster access and a hardware cost one fourth that of traditional vector registers can be had by using a vector register that incorporates a pipelines, random-access-memory chip. If a large enough set of registers is used, the need to store temporary results in memory and then reload them for later use can be eliminated; this saves both instruction-stream bandwidth and execution time. 111 refs., 43 figs., 40 tabs.

52935 **Development of parallel methods for a 1024-processor hypercube.** Gustafson, J.L.; Montry, G.R.; Benner, R.E. (Parallel Processing Div., 1413, Sandia National Labs., Albuquerque, NM (US)). *SIAM Journal on Scientific and Statistical Computing;* 9: No. 4, 609-638(Jul 1988).

The authors developed highly efficient parallel solutions for three practical, full-scale scientific problems: wave mechanics, fluid dynamics, and structural analysis. Several algorithmic techniques are used to keep communication and serial overhead small as both problem size and number of processors are varied. A new parameter, operation efficiency, is introduced that quantifies the tradeoff between communication and redundant computation. A 1024-processor MIMD ensemble is measured to be 502 to 637 times as fast as a single processor when problem size for the ensemble is fixed, and 1009 to 1020 times as fast as a single processor when problem size per processor is fixed. The latter measure, denoted scaled speedup, is developed and contrasted with the traditional measure of parallel speedup. The scaled-problem paradigm better reveals the capabilities of large ensembles, and permits detection of subtle hardware-induced load imbalances (such as error correction and data-dependent MFLOPS rates) that may become increasingly important as parallel processors increase in node counts. Sustained performance for the applications is 70 to 130 MFLOPS, validating the massively parallel ensemble approach as a practical alternative to more conventional processing methods. The techniques presented appear extensible to even higher levels of parallelism than the 1024-processor level explored here.

52936 **LU factorization algorithms on distributed-memory multiprocessor architectures.** Geist, G.A.; Romine, C.H. (Mathematical Sciences Section, Oak Ridge National Lab., P.O. Box Y, Oak Ridge, TN (US)). *SIAM Journal on Scientific and Statistical Computing;* 9: No. 4, 639-649(Jul 1988).

In this paper, the authors consider the effect that the data-storage scheme and pivoting scheme have on the efficiency of LU factorization on a distributed-memory multiprocessor. The authors' presentation focuses on the hypercube architecture, but most of the results are applicable to distributed-memory architectures in general. The authors restrict their attention to two commonly used storage schemes (storage by rows and by columns) and investigate partial pivoting both by rows and by columns, yielding four factorization algorithms. The authors' goal is to determine which of these four algorithms admits the most efficient parallel implementation. They analyze factors such as load distribution, pivoting cost, and potential for pipelining. They conclude that, in the absence of loop-unrolling, LU factorization with partial pivoting is most efficient when pipelining is used to mask the cost of pivoting. The two schemes that can be pipelined are pivoting by interchanging rows

when the coefficient matrix is distributed to the processors by columns, and pivoting by interchanging columns when the matrix is distributed to the processors by rows.

52937 **Reducing the branch penalty in pipelined processors.** Lilja, D.J. (Univ. of Illinois at Urbana-Champaign (US)). *Computer;* 21: No. 7, 47-55(Jul 1988).

Pipelining improves computer performance by overlapping the execution of several different instructions. If no interactions exist between instructions in the pipeline, then several instructions can be in different stages of execution simultaneously. This article develops a probabilistic model to quantify the performance effects of the branch penalty in a typical pipeline. The branch penalty is analyzed as a function of the relative number of branch instructions executed and the probability that a branch is taken. The resulting model shows the fraction of maximum performance achievable under the given conditions. Techniques to reduce the branch penalty include static and dynamic branch prediction, the branch target buffer, the delayed branch, branch bypassing and multiple prefetching, branch folding, resolution of the branch decision early in the pipeline, using multiple independent instruction streams in a shared pipeline and the Prepare-to-branch instruction.

52938 **Transport equations with second-order differential collision operators.** Cosner, C.; Lenhart, S.M.; Protopopescu, V. (Dept. of Mathematics and Computer Science, Univ. of Miami, Coral Gables, FL (US)). *SIAM Journal of Mathematical Analysis;* 19: No. 4, 797-813(Jul 1988).

This paper discusses existence, uniqueness, and a priori estimates for time-dependent and time-independent transport equations with unbounded collision operators. These collision operators are described by second-order differential operators resulting from diffusion in the velocity space. The transport equations are degenerate parabolic-elliptic partial differential equations, that are treated by modifications of the Fichera-Oleinik-Radkevic Theory of second-order equations with nonnegative characteristic form. They consider weak solutions in spaces that are extensions of L/sup rho/ to include traces on certain parts of the boundary. This extension is necessary due to the nonclassical boundary conditions imposed by the transport problem, which requires a specific analysis of the behavior of our weak solutions.

52939 **An optimal circulant preconditioner for Toeplitz systems.** Chan, T.F. (Dept. of Mathematics, Univ. of California, Los Angeles, CA (US)). *SIAM Journal on Scientific and Statistical Computing;* 9: No. 4, 766-771(Jul 1988).

Given a Toeplitz matrix A, the authors derive an optimal circulant preconditioner C in the sense of minimizing norm of C - A/sub F/. It is in general different from the one proposed earlier except in the case when A is itself circulant. The new preconditioner is easy to compute and in preliminary numerical experiments performs better than Strang's preconditioner in terms of reducing the condition number of C/sup -1/ A and comparably in terms of clustering the spectrum around unity.

52940 **High speed data compactor.** Baumbaugh, A.E.; Knickerbocker, K.L. (to Dept. of Energy, Washington, DC). US Patent 4,751,572. 14 Jun 1988. Filed date 30 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

An apparatus for non-destructively compressing data in a stream of N-bit data words from a source of informational and non-informational data words, is described comprised of: comparison means coupled to the data source for comparison testing N-bit data words in the data stream against a predetermined N-bit binary threshold value; a counter means coupled to the comparison means for forming a count word of N binary digits; first flag bit means coupled to the comparison means and the counter means for forming a first (N + 1) bit digital word which included a first valued binary flag digit appended to such of the N bit data words from the data source exceeding the threshold value; second flag bit means coupled to the comparison means for forming a second (N + 1) bit digital word; and means coupled to the first flag bit means and the second flag bit means for selectively transmitting to a data processing system either the first N + 1 bit word or the second N + 1 bit word.

52941 **External fields and the renormalization group.** Clark, T.E.; Love, S.T. (Dept. of Physics, Purdue Univ., West Lafayette, IN (US)). *Modern Physics Letters B;* 3: No. 7, 661-666(Jun 1988).

Scaling arguments are used to relate the external field dependence of the vacuum functional to the changes in the other parameters characterizing the model. Under certain circumstances, this renormalization group equation can be solved, at least approximately, for the external field dependence of the effective action. In particular the authors focus on the case of a strong external magnetic field.

9903 Information Handling

REFER ALSO TO CITATION(S) 50573, 51216, 51376, 52626

52942 **(CNIC—00136) Multifunctional data acquisition and processing system based on microcomputer.** Chen Huaide; Pan Dajin; Zhu Cuiqin; Wang Guangyu; Wang Shibo; Niu Wanfu; Gu Jinglan; Tang Yunli. (Academia Sinica, Beijing (China). Inst. of Atomic Energy). (China Nuclear Information Centre, Beijing, BJ). 1988. 10p. (In Chinese). (IAE—0034). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704106/JAW.

A data acquisition and processing system based on microcomputer TRS-80 has been developed since 1983 and has been operated for years. The system is a multifunctional MCA-Computer system which can be operated as a foreground and a background with the capabilities of high resolution in γ-ray spectrum analysis, multiplex multi-scale, multi-scale and the display system having the resolution up to 8192 points. MCA is 8192 channel with 20 bits 8 k buffer memory. First, the acquisition data is stored into the buffer memory. Then, it is transfered into computer for processing. The system software consists of the system management, spectrum processing and multiplex multi-scale measurement softwares. This article gives the block diagram of the system, the specifications, application and results.

52943 **(EGG-M—88216) Information resource management: An architectural concept/experience.** Linsenmann, M.K. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 20p. (CONF-8809112—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015184/JAW.

From International software AG users group; Nashville, TN, USA (25 Sep 1988).

This paper contains an integrated Database System strategy utilizing a System Architecture concept comprised of the following components: Data Integration (Data Administration and Database Administration); Single-System change (Application Architecture); and Business System Integration.

52944 **(FIPS/PUB—130/XAB) Intelligent Peripheral Interface (IPI). Category: hardware standard, Subcategory: interface. Federal Information Processing Standards publication (Final).** Burr, W.E. (National Bureau of Standards, Washington, DC (USA)). 16 Jul 1987. 491p. NTIS, PC E20.

Three ring vinyl binder also available, North American Continent price $7.00; all others write for quote.

The standard defines the functional, electrical, and mechanical specifications for a 16-bit parallel master/slave-bus interface, suitable for connecting a host computer or controller to mass storage peripherals. The standard also provides the following command set specifications: (a) Device Specific Command Set for magnetic Disk Drives; (b) Device Generic Command Set for Magnetic and Optical Disks; (c) Command Set for Generic Tape; The standard facilitates plug-to-plug interchangeability of storage equipment as a part of computer systems. The Government's intent in employing this standard is to reduce the cost of satisfying its data processing requirements through increasing its available alternative sources of supply for computer systems components at the time of initial system acquisition, as well as in system replacement and augmentation and in system component replacement. This standard is also expected to lead to improved reutilization of system components.

52945 **(FIPS/PUB—131/XAB) Small-Computer System Interface (SCSI). Category: hardware standard, Subcategory: interface. Federal Information Processing Standards publication (Final).** Burr, W.E. (National Bureau of Standards, Washington, DC (USA)). 16 Jul 1987. 225p. NTIS, PC E10.

Three ring vinyl binder also available, North American Continent price $7.00; all others write for quote.

The standard defines the functional, electrical, and mechanical specifications for an 8-bit parallel bus, suitable for connecting physically small computers to each other and to mass storage peripherals. It also defines the operational specifications (command sets) for the following devices: (a) Sequential-Access Devices (e.g., magnetic tape); (b) Direct-Access Devices (e.g., magnetic disks); (c) Printer Devices; (d) Write-once Read Multiple Devices (e.g., optical disks); (e) Read-Only Direct-Access Devices (e.g., read only optical disks); (f) Processor Devices; The Government's intent in employing this standard is to reduce the cost of satisfying its data processing requirements through increasing its available alternative sources of supply for computer system components at the time of initial system acquisition, as well as in system replacement and augmentation and in system component replacement. The standard is also expected to lead to improved reutilization of system components.

52946 **(INDC(NDS)—192/L, pp 43-53) Neutron interaction cross-section covariance data and their processing codes available from the NEA Data Bank.** Sartori, E. (NEA Data Bank, 91 - Gif-sur-Yvette (France)). Jan 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88703867/JAW. (CONF-861193—).

From IAEA specialists' meeting on covariance methods and practices in the field of nuclear data; Rome, Italy (17 Nov 1986).

The current status of computer codes for uncertainty analysis in neutron transport problems, covariance data and their processing codes, data consistency and adjustment codes using covariance data that are available from the NEA Data Bank are described. (author). 19 refs, 1 fig., 2 tabs.